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Information systems simplification : a demonstration model in higher education.

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INFORMATION SYSTEMS SIMPLIFICATION:
A DEMONSTRATION MODEL IN HIGHER EDUCATION

A Dissertation Presented

By

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Education

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Mario Fantini, Dean
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Lovingly dedicated to those

who made this possible...

My wife, Elaine

My sons, Stephen and Lawrence

My father, Carl O. Kaiser

My mother, Elizabeth Richards Kaiser

ABSTRACT

Information Systems Simplification:
A Demonstration Model in Higher Education

February 1977

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This thesis presents an experimental model computerized information system designed for use in colleges and universities. The design philosophy of the model system synthesizes many design ideas and the latest trends in equipment development to produce an administrative information system that is more flexible and less complex than most of today's existing systems.

The pressing need for data systems that are both flexible and dependable is discussed in the Problem Statement. The point is made that most present systems suffer from over-complexity, and that this over-complexity limits the use of computerized systems on campus. A review of the pertinent literature illustrates the development of computerized information systems on campus and supports the growing awareness in the field that computer systems have become too complex to be properly controlled.

The model information is presented in non-technical form in the text and with full technical documentation in the Appendix. A simplified master file design is presented that utilizes standardized short fixed-length data records to store all data in the system in a common data base. The data base is controlled and accessed through the use of an inverted dictionary file that also controls both input edit and report generation functions. A series of interrelated computer programs is also presented that provide overall support for the data base system.

Possible methods of evaluation of the model system are discussed, and implementation steps are outlined for all phases of the administrative data system designed in the model.

CONTENTS

PREFACE

About thirteen years ago, when I first began to aspire to be a part of the developing profession of Information Systems Architecture, I was working as an accounting systems analyst at the Bank of Hawaii in Honolulu. At that time I became sensitized to the communications gap that existed (and still exists) between the technicians who develop computer systems and the administrators who are supposedly served by those systems. I began developing some of the tools which, now refined and synthesized, are presented as the systems model described in this dissertation.

During these intervening years, as a management consultant and educator, I have observed with increasing concern the negative impact that some aspects of the computer (or information systems) revolution have had on our society. As a professional in the field, I am well aware of both the substantial benefits and various problems that computer useage has brought to our culture. While many of the problems are being addressed in the literature and by the legislatures, two problems that I see as being related are receiving too little attention. One is the continuing trend toward excessive complexity in the development of computerized information systems. The other is an apparent dehumanizing effect that such automated systems have on those who are either directly or indirectly the subject of information being manipulated by these systems.

Computers are here to stay. No Luddite revolt will expunge them from our society. Computers, as tools in the hands of man, can bring to mankind good or evil or some combination of these two. If the computer as a tool can bring confusing complexity and rigidity to our decision-making functions, it can also be used to bring enlightenment and simplicity to those functions. If the computer can be used to befuddle and dehumanize segments of our society, it should be possible for the same concepts of applied information systems to some day bring greater understanding and humanity to mankind. I am devoting my life to reversing these present trends toward dehumanization by computerized information systems. This document is devoted to the less confounding but still significant problem of reversing the trend toward excessive complexity in computerized systems. Many college and university campuses have been effected by both dehumanization and bureaucratic rigidity caused possibly by inadequate planning in the development of computerized administrative systems. It is hoped that the model system developed in this document will be a step toward solving the problem of over-complexity and also toward greater human understanding through better information.

I wish to express my sincere appreciation and deep gratitude to those who have assisted me in developing the ideas that are integrated in this model system. Paramount among those mentors are Dr. G. Ernest Anderson, Jr., Dr. Van Court M. Hare, Jr., Dr. O. C. Bobby Daniels and Dr. Craig L. Moore. I am no less indebted to my wife, Elaine, whose supportive attitude, gentle criticism and diligent typing helped me greatly.

Richards W. Kaiser
April, 1977

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CHAPTER I

INTRODUCTION

While some major universities have been involved with electronic computers from their first development during World War II, most early computer useage was devoted to research. The adaptation of computer facilities for administrative purposes was usually subordinated to the research function. Still, during the nineteen-fifties some institutions began to convert their existing punched-card or manual systems to computers for such basic administrative functions as payroll and student record-keeping. These uses related to the stewardship[1] role that administrators in higher education had performed for many years. This role limited administrators to bookeeping and record-keeping chores.

During the past twenty-five years the role of the administrator has been greatly expanded in many colleges and universities. The increasing influence of the federal government in higher education is at least partly responsible for this change. The greatly increased federal aid to higher education during the "sputnik" era[2] resulted in

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[1] An interesting discussion of earlier administrative methods is found in Lindsay, E. E., and Holland, E. O., College and University Administration, Macmillan, New York, 1930, p. 449.

[2] A summary of federal programs in the fifties is found in Horrigan, A. E., "Government Relations", in The College Business Office, Catholic University Press, Washington, D. C., 1960, p. 150.

more reports to be provided to the federal government. At the same time there were more students and faculty to serve, and more buildings and other assets to acquire and control. During the middle nineteen-sixties the continued expansion of college and university campuses was accompanied by strong pressures on administrators to cope with student unrest and the subsequent alienation of many of the traditional supporters of higher education. More recently we have seen a slowing or reversal of the growth trend on campuses. Traditional sources of revenue have fallen behind increases in operating costs. Various faculty and student groups have made conflicting demands on administrators as they competed for increasingly scarce resources.[3] Within this demanding and changing environment the stewardship role of college and university administrators has gradually changed to a role of active management. This movement has not occurred without resistance, and the issue is far from being settled.

To better understand the changing role of computers in administrative information systems, it is relevant to review briefly the changing role of the administrator within the campus organization. There are currently a number of different views of college and university organization. The

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[3]Perkins, James A., The University as an Organization, for the Carnegie Commission on Higher Education, McGraw-Hill, N. Y., 1973, p. 60.

administrator is seen as a member of one of the many groups on campus that compete for power and resources.

Baldridge,[4] Gross and Grambsch,[5] and Perkins[6] view the university as an organization which is in nearly constant political turmoil. Referring to power conflicts between campus groups, Baldridge writes,

> "conflict theorists emphasize the fragmentation of social systems into interest groups, each with its own particular goals; ...they then study the interaction of these different interest groups and especially the conflict processes by which one group tries to gain advantages over another."[7]

In this case, the gradually increasing power of campus administrators is seen as possibly exacerbating campus conflicts that the administrators seek to mollify, since older power centers (such as different faculty groups) may be competing with each other and with the administration to retain both power and newly limited resources. This centralization phenomena in campus administration was supposed to lead toward greater efficiency. This goal has not been substantially realized.

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[4]Baldridge, J. Victor, Power and Conflict in the University, Wiley, N. Y., 1971, p. 206.

[5]Gross, Edward, and Grambsch, Paul V., Changes in University Organization, 1964-1971, for the Carnegie Commission on Higher Education, McGraw-Hill, N. Y., 1974, p. 170.

[6]Perkins, op. cit., p. 34.

[7]Baldridge, op. cit., p. 207.

The Carnegie Commission also reports that faculty members are more divided now than they have been in decades over the appropriate forms of campus administration and governance.[8] Some of the causes of campus conflict are listed by Baldridge as: differences in language (professional argot), sources of income (teaching, research grants, consulting), styles of research (loaner or team-mate) and prestige factors (publications versus consulting versus teaching). In the literature there is an implication of nearly constant organizational change, as faculty groups, students, administrators and outside groups (trustees and/or state control boards) maneuver for power.[9]

Historically, the classical model of a collegium of scholars has been an ideal much sought but seldom attained. Nevertheless, certain smaller colleges today exhibit a high degree of conformity to this collegium model...especially some of the church-supported colleges of the mid-west.[10]

Other analysts see the campus organization in a more hierarchical (bureaucratic) sense. The extreme of this view

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[8] ____________, Governance in Higher Education, a report of the Carnegie Commission on Higher Education, McGraw-Hill, N. Y., 1973, p. 76.

[9] An interesting current example of this is discussed in "College and University Government: The University of Texas at El Paso", AAUP Bulletin, Summer 1974, pp. 126-139.

[10] Helsabeck, Robert E., The Compound System, Center for Research and Development in Higher Education, The University of California, Berkeley, 1973, p. 30.

perceives a fractious faculty in competition with an increasingly strong central administration for both resources and political power. Perkins' statement of this position seems most relevant:

> "Faculties have created a hierarchy of departments, schools and senates which ...claims rights of control over the totality of the academic function. On the other hand, administrators have formed a separate hierarchy to grapple with the immense tasks of management of essential yet supportive services which maintain the university...
>
> "The lines of relationship between the two bureaucracies have become tenuous. ...Faculty remain committed to a traditional ideal of the university as an integrated community, at the same time giving constant evidence that they fail to grasp its real operational nature and managerial complications. Administrators find their managerial tasks so consuming that they become forgetful of the nature of the academic enterprise.
>
> "This condition (of competition) is reinforced by academic condescension toward administrators, who are viewed as servants rather than leaders of the professoriate. It reflects what one might call a faculty schizophrenia which catagorizes administrators as minions while condemning them for failure to stand firmly as defenders of the academic faith in times of crisis. At times this divergency threatens an atrophy in leadership for large universities in an era when leadership is of utmost importance."[11]

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[11] Perkins, op. cit., p. 35.

A modification of the bureaucratic viewpoint is expounded by those who examine the university organization in terms of power or decision-making centers. While Baldridge states that "the power structure of the university is ... loose, ambiguous, shifting and poorly defined"[12], he goes on to discuss some universities as having a "federated" power structure consisting of "a bewildering collection of schools, colleges, and institutes, loosely bound together under the university's control but generally going about their own private concerns with little relation to the rest of the institution."[13]

While the viewpoints expressed above cover the main ideas of some prominent researchers, there are yet other opinions which cannot be more than acknowledged, due to the summary nature of this introduction. The important point is that all the organizational models discussed above are valid in the sense that colleges or universities can be found in this country which appear to fit the different models with some degree of accuracy.

Such a diverse set of models greatly complicates the understanding of information flows in such organizations. This not only complicates the design of improved organizational information systems, it tends to make individuals

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[12]Baldridge, _op_. _cit_., p. 197.

[13]Baldridge, _op_. _cit_., p. 83.

within the organizations more dependent on peer group support and less identified with higher organizational goals.[14] This, in turn, further confuses the information picture. It also makes it more difficult to obtain a consensus when seeking to make improvements in the flows of information.

It is within this changing, confusing and often hostile environment that the development of administrative information systems for colleges and universities has taken place. It is also within this context that an improved data base and information systems design will be developed.

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[14] See French, John P., Jr., and Raven, Bertram, "The Bases of Social Power", in Group Dynamics (Cartwright and Zander, ed.), Harper and Row, N. Y., 1968, p. 266.

CHAPTER II

PROBLEM STATEMENT

During the past two decades, as college and university administrators grew in numbers, power and responsibility, the administrative use of computers on campus has greatly increased. Most of the computer applications were and still are in areas related to the bookkeeping or record-keeping function. Basic operational information (such as payroll for faculty, student employees and staff, personnel records for all employees, and academic records for students) was the first concern of the administrators. The larger universities took the lead in developing these basic operational systems to process their daily paperwork transactions. In essence, the transaction-oriented systems were quite similar to the manual or bookkeeping-machine record-keeping systems they replaced. Data relating to each transaction was usually punched into cards and then processed by a computer to provide summary reports of daily, weekly or monthly operations in a particular administrative office.

As the technical capabilities of both the machines and the programmers improved (along with the larger responsibilities, and greater power of administrators) the systems were improved to include historical summary data and more sophisticated operating statistics on some reports. Further development took place as the federal and state government began to ask for more information in relation to their assistance programs. According to Caffrey and Mosmann, "each new federal program of financial aid requires the reporting of new data. Rising costs generate increased demands for information by regents, trustees, and legislators to justify rising budgets. Development and fund-raising programs need solid information to support appeals to alumni, foundations, and other sources. The chairman of one board of trustees reported a sad experience with his state legislature:

> We went to them with a biennial budget 15 percent higher than the previous one. We lost every bit of the increase, because we couldn't answer some of the simplest questions of the legislative committee on finance. They cut us to pieces. Next time we've got to be ready for them."[1]

Such demands provided strong stimulus for campus administrators to develop higher level summary reports for the control and coordination of the academic enterprise.

The Office of Education (U. S. Department of Health, Education and Welfare) has had great influence on the development of higher level administrative control systems at colleges and universities. Before 1966, this federal office sent out general information forms seeking data on a number of subjects: students and their characteristics, the faculty, financial operations, and a variety of special

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[1]Caffrey, John, and Mosmann, Charles J., <u>Computers on Campus</u> American Council on Education, Washington, D. C., 1967, p. 37.

inquiries. Subsequently, the Office of Education has developed a single package of questionnaire forms that has provided greater organization and predictability of data requirements. This Higher Education General Information Survey (HEGIS) asks for data compilations that may be difficult, if not impossible, for an institution to develop on a timely basis if it were not for computerized record-keeping systems. Table 1 (following page) illustrates some of these data requirements.

Table 1

A Partial Listing of Current and Proposed HEGIS Projects

Students:

- Opening fall enrollments --gross totals
- Degree granted - by academic field
- Enrollment for advanced degrees - by field
- Migration and residence
- Upper division undergraduate by field
- Summer enrollments
- Course enrollments by academic field
- Student credit hours taught by field
- Cost to student
- Common codes for all academic areas
- College graduates, progress after degrees
- Admissions standards

Faculty:

- Full-time and part-time by academic field
- Faculty salaries by rank and academic field
- Number of summer faculty
- Degrees held, background and experience
- Faculty teaching loads
- Research activity of faculty
- Faculty motivation for employment
- Faculty retention

Finance:

- Total current revenue and expense by source, fund and function
- Capital receipts, capital loans, physical plant dept, and endowments
- Federal funds information
- Unit cost or activity cost
- Research operations cost

Space:

- Type and amount of space by function and academic field
- Utilization of instructional and research space

Source: Office of Education, as quoted in "Critique by Geo. W. Baughman", Management Information Systems in Higher Education, C. B. Johnson, ed., Duke Univ. Press, Durham, N. C., 1969.

In spite of the stimulus provided by federal and state agencies, during the mid nineteen-sixties "most American colleges and universities lagged behind government and industry in using computers for administration. Reasons for this vary, but the cited justifications generally boil down to two hard-core reasons: a refusal to face the problem; or a refusal to pay for its solution. 'Waiting for Dr. X to retire is the usual symptom of the first case. Dr. X is always an important member of the power structure who his colleagues fear they may offend."[2] Finally, during the latter part of the decade, great numbers of smaller colleges began to join those larger institutions that pioneered administrative applications on the computer. Perhaps this change was due to the reduced cost of newer small computers (and their increased reliability), or possibly "Dr. X" finally retired. The magnitude of the change is illustrated by Table 2.

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[2] Caffrey and Mosmann, _op_. _cit_., p. 39.

Table 2

Percentage of Institutions Using Computers in Administration (by number of students)

Size:	1000 or less	1000-5000	5000-10000	10000-15000	15000-20000	over 20000	Total
1965	9.8	36	79		86		31.5
1967	11.5	44.5	88.2		95.4		41.4
1970	28.4	69.3	93.3	97.6	100		61

Source: Surveys of the American Association of Collegiate Registrars and Admissions Officers, 1965 - 1970.

This increase in the number of administrative computers in use was accompanied by equally important changes in the ways the computers were used. Before this time, according to Mosmann, many top campus administrators were unaware that the new computers could be of any benefit to them.

> "Deans and vice-presidents, department chairmen, trustees, chancellors, and provosts live in an environment that is highly unstructured and very rich in non-quantitative values. They have important decisions to make and they need information on which to make them. But they often do not view their efforts as a deliberate collection and analysis of information. They talk to many people and collect impressions and ideas; they do not consciously structure or evaluate these data; when the time comes to make a decision, they may feel they act intuitively, basing their decisions on a humanistic awareness of values and goals. When they are offered more precise information, they may doubt that it will be of any value to them."[3]

During the period between 1965 and 1970 many administrators were convinced that top level functions of planning and policy formulation could also be assisted by the computer. Thus developed the three levels of information systems for colleges and universities that are of primary concern today. According to Van Dusseldorp, "Information needed for a college to function can be divided into three levels: (1) information for operations, (2) information for control, and (3) information for management decisions and planning.

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[3]Mosmann, Charles, Academic Computers in Service, Jossey-Bass, San Francisco, 1973, p. 127.

The lowest level (1) ...consists of information needed for clerical functions - payroll, student records, financial transactions, and the like. The middle level, information for control, involves information needed to implement administrative decisions and policies."[4] An example of this might be an accounting report that indicates when a certain item on a department's budget has been over-expended. If the policy has been made that the particular item were to be strictly controlled, an administrator would then use the information on the report to reject or return for more justification any further expenditure for the item.

Information for planning and policy-making must have the potential for greater flexibility, due to the unstructured nature of this level of decision-making. Also, the method by which basic transaction data is aggregated (summarized) from possibly several different sources for a planning-level report is of great importance. A top administrator must be able to obtain information rapidly, accurately and in a form that is meaningful for his or her needs. The information must be "trustworthy" if the system that provides it is going to be used enough to prove itself. Trustworthy information is provably and dependably accurate.

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[4]Van Dusseldorp, Ralph, "Some Principles for the Development of Management Information Systems", in Management Information Systems for Higher Education, Johnson and Katzenmeyer, ed., Duke University Press, Durham, N. C., 1969, p. 30.

If the system is not trusted it will not be used. Here lies the central problem which we wish to address.

The Problem

We have seen that most administrative computer systems in higher education were first implemented on campus between five and fifteen years ago. This was a period during which many campus administrators were concerned with automating the basic clerical and operational functions (level one), with some information being provided to the next level for control purposes. Therefore, the basic design of the systems that provided this information was oriented toward maximizing the computer's efficiency in processing basic transaction data for particular level one functions (payroll, student records, etc.).

Today the thrust in information systems is toward providing top and middle level administrators with assistance in policy-making and planning. Unfortunately, the data forms and formats that may have been adequate for level one systems appear to be inadequate for level three systems. The highly structured systems that seem to serve the operational functions (level one) do not lend themselves readily to the needs of the level three administrator.

In these times of increasing financial difficulties for most institutions, top administrators are faced with more and more controls that are being placed upon the institutions by federal and state agencies. There are now about 350 separate federal programs that affect postsecondary education. Most of these programs require some kind of information to be provided by the institutions receiving benefits.[5] In addition, the Office of Education continues to pursue its general mandate to "collect statistics and facts showing the condition and progress of education in the United States and to disseminate such information respecting the organization and management of schools and school systems..."[6]

Many campuses have established offices of institutional research in order to coordinate the gathering of information needed by top administrators and outsiders. According to Dressel, "the cacaphony of demands makes it necessary for institutions to know what they are doing, to have rational bases for their decisions, and to be honest and open in dealing with all their publics. ... Institutional research and information systems cannot bring about utopia in higher education; but higher education cannot be open and rational until it has the factual basis in data collection and study to permit sound evaluation of resource allocation and of

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[5] Andringa, Robert C., "New Demands by Government for More Information from Postsecondary Education", Conference Proceedings, Education Commission of the States, Denver, Colorado, Report No. 49, 1974, p. 54.

[6] Ibid., p. 57.

the consequent quality of education provided."[7]

The institutional research groups have developed a number of sophisticated tools that utilize concepts taken from management science, statistics, mathematical modeling, information systems and other disciplines.[8] However, many of these tools also require current and accurate data from the operational transactions (level one) in order to fulfill their promise. From the standpoint of the computer center, the office of institutional research may simply represent another user of the machine and the data base of operational transactions. The sophistication of the institutional researchers may make them more understanding of the limitations of the current information system, but this same sophistication may make them more insistant on optimum computer center performance.

A major problem of today's postsecondary information systems is the inflexibility of the basic data files that

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[7]Dressel, Paul L. and Associates, Institutional Research in the University, Jossey-Bass, San Francisco, 1971, p. 16.

[8]A summary of the current status of Institutional Research may be found in Gulko, Warren W., and Lukens, Pauline F., "Managerial Styles and Decision-making in Higher Education", in Information for Decisions in Postsecondary Education, The Association for Institutional Research, 15th Annual Forum, St. Louis, 1975, p. 122.

see also Lockwood, Geoffrey, "Use of Models in Institutional Management", in University Planning and Management Techniques, Organization for Economic Cooperation and Development, Paris, 1972, p. 85.

are used as the source of information for all levels in the system. Now that we have reviewed the organizational background and the development of a demand for dependable information by that organization, we can examine the technical problems which this dissertation addresses.

Inflexibility and Over-complexity

Most computer programs and their related data files that were developed by colleges and universities during the past twenty years are now too inflexible to meet the needs of a continuingly changing constituency of users. There are several historical factors which are behind the present systems inflexibility:

a. Computer programmers and systems analysts have in the past developed reports and data files with very limited scope. Their jobs were to satisfy a certain user (or group of users) who determined the design criteria for the system involved. Adequate thought was seldom given to the future possibility of linking one particular sub-system to another (such as connecting payroll with the personnel records system) in order to provide reports that were more useful to higher management levels.

b. The design of computerized data files tended to emphasize machine efficiency rather than human efficiency. Once the needs of the direct users were met, the main goal of the programmer/analyst was to design files and programs which would allow maximum computer efficiency.

c. Time and budget pressures (as well as programmer disdain) caused computer program documentation to be neglected.

d. It was easier to get funds for improved computer hardware than to fund an expensive reprogramming effort. Computer programs which became obsolete often have been maintained through repeated "patching", even though they may have been written in a computer language which under-utilized the newer computer hardware. Such computer programs become extremely inflexible when they are not properly documented. (see item c. above).

e. To enhance machine efficiency, computer data files were often designed to contain only the data related to one or two reports. Again in the name of machine efficiency, the data records on the files were often very long. Since all data records are coded in some way to provide computer identification, a long data record allowed more data to be stored and processed in relation to the code "overhead". For example, a payroll record might only have a five-character employee number code to differentiate it from other records in the file. The rest of the data in the payroll record might fill 300 characters (name, social security number, pay deductions, etc.).

These factors combined to limit the flexibility of present data systems in meeting the needs of university administrators. Writers such as Baughman[9] and Caffrey[10] in the mid-nineteen-sixties began to call attention to these problems. The traditional design methods outlined above were efficient only until the user required a change in the reports that called for data that was not already in the related computer file. In many

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[9]Baughman, G. W., "Critique", in Management Information Systems in Higher Education, Johnson and Katzenmeyer, ed., Duke University Press, Durham, N. C., 1969, p. 106.

[10]Caffrey and Mosmann, *op*. *cit*., p. 174.

such cases, file records had to be enlarged or re-formatted to include the new data. This necessitated the costly re-programming of each computer program that used the affected files. In cases where the documentation of the old programs was inadequate (or non-existant...the usual case), the user had the choice of either paying for a complete new system or of forgetting about the needed report changes (making adjustments to computer reports by hand).

Some of the smaller schools that were just beginning to implement computerized operational systems were able to heed the warnings referred to on the previous page and take steps to make their data files more flexible. But most institutions were not able to halt the development of new systems applications long enough to re-design older systems. During the late nineteen-sixties the concept of a Management Information System for higher education became accepted by many persons who worked with administrative systems in the larger institutions. This concept envisioned the computer eventually providing decision-oriented information to individual decision-makers at all levels in an administrative organization.[11] All decision-makers were to have rapid access to the latest information on which to base their decisions.

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[11] A good summary of this approach is contained in Baughman, George W., "Towards a Theory of University Management", in Management Information Systems in Higher Education, op. cit., p. 29-32.

For several years the administrative journals and other publications[12] contained many articles describing progress on this or that new management information system (MIS). Much time and money was spent to develop practical administrative applications of decision theory within a management information system. Unfortunately, by the early nineteen-seventies two great problems with these ideas had been recognized. First, budgetary limitations began to restrict the voracious costs of new systems development. Second, the technical difficulties involved in bringing together different data items from many different files to develop the necessary management reports began to overwhelm the systems designers and programmers. In addition, the memory requirements of some of the complex summarization programs became more than the computers could accept without costly expansion.[13] There is little evidence that management information systems projects were officially cancelled. They simply faded from the literature. In any case, not one major university has succeeded in installing a comprehensive management information system.

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[12] A summary and partial bibliography relating to the state of the art is contained in Godwin, William, "Academic Data Banks", in <u>The Computer Utility: Implications for Higher Education</u>, Heath and Co., Lexington, Mass., 1970.

[13] A critique of these developments is found in ___________, <u>Institutional Management in Higher Education</u>, Center for Educational Research and Innovation, Conference Report, 1972.

New Developments

When the restrictive data file organization was identified as a major limiting factor in the design of improved management systems, strenuous attempts were made to attack this problem. A summary of this situation is presented by Cushing:

> "Organizations which have used computers in data processing for several years have typically experienced a proliferation of computer applications. Often this has led to growing problems concerning the management of data. For example, the same item of data, such as an inventory balance on hand, might be needed in several different computer applications. Under the traditional approach, separate files would be maintained for each application. This leads to data redundancy, where the same item of data is stored in several different places within an information system.
>
> "In addition to requiring greater amounts of file storage space, data redundancy can result in inconsistencies between data items which should agree. For example, one record may indicate that the balance on hand of a particular inventory item is 200 units, while another record shows 120 units. The confusion which may result from this problem tends to negate the advantages of computerized data processing."[14]

After considerable re-evaluation, a new effort has been mounted to solve the problem of system inflexibility. The new developments have taken three forms:

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[14]Cushing, Barry, Accounting Information Systems and Business Organizations, Addison-Wesley, Reading, Mass., 1975, p. 181.

a. Smaller colleges which have not gone far in previous computerization efforts are beginning to design total educational information systems from the start. Some of these systems are very sophisticated. Most are very complex. It is too early to judge their flexibility. (These new developments are discussed more fully in the following chapter).

b. Some larger institutions (such as Southern Illinois and the University of Utah) are phasing out their old systems and are building entirely new integrated management information systems. These systems are more coherent than their old systems, but they are appallingly complex and very expensive.

c. The need for a more coordinated approach to data management has led to the present data base approach. A data base may be defined as a set of interrelated data files which are stored with as little data redundancy as possible and which may be accessed by one or more application programs. The specialized computer program which manages the data and interfaces between the data and the application programs is referred to as a Data Base Management System (DBMS).[15]

The Data Base Management System is now offered by many vendors as the panacea for system inflexibility. These systems are pre-packaged computer routines which (with much effort) reformat the many different existing files of the institution into more flexible arrangements of linked data files.

While no large institution has yet fully implemented a DBMS, many installations are underway. Smaller schools have been able to utilize the DBMS more rapidly, since their

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[15]Cushing, op. cit. From a new section on data base systems which will be added to the book in its new edition.

systems were less complex to begin with and they do not have so many different files to convert to the DBMS format. An excellent example of such a system is installed at the Three College Data Center, at Amherst College.[16] While the DBMS approach does organize computer files and provide needed systems flexibility, all present Data Base Management Systems utilize file design and computer program logic that is incomprehensible to all but the most sophisticated computer professionals.

This newly recognized problem of over-complexity further restrains the full utilization of the computer as an administrative tool. According to Patrick[17] the complexity of large computerized data base systems has risen faster than has our ability to cope with it. He goes on to state,

> "...Two or three years ago progress in the big computer shops stopped when system complexity equalled the ability of the staff to cope with it."

Thus we have defined the problem: college and university administrators have not been able to fully utilize the potential benefits of computerized information systems due to the inflexibility and over-complexity of the system design, and due to a well-founded lack of trust in the data they receive

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[16] See Plourde, Paul J., "TOTAL", from Millard, R., ed., Planning and Management Practices in Higher Education, Education Commission of the States, Denver, 1972.

[17] Patrick, Robert L., Editorial in DATAMATION, May, 1976, p. 8.

from that system.

It seems evident that a less complex and more flexible approach to information system design would permit both more flexible decision patterns in higher educational organizations and a better understanding by administrators of the data upon which they must base their decisions. The following chapters will probe the problem in greater depth and present a model system that is designed to be both less complex and more flexible.

CHAPTER III

A REVIEW OF THE LITERATURE RELATED TO HIGHER EDUCATIONAL MANAGEMENT SYSTEMS

Before reviewing some of the computerized approaches to college and university management, it seems appropriate to acknowledge the continuing existence and effectiveness of manual accounting and control procedures in many institutions. The basic textbook on the subject is College and University Business Administration.[1] The procedures for management and control presented by this text are not difficult to understand. They reflect the basic simplicity of many institutional accounting and control procedures. The manual systems are easier to audit and control than many of today's computerized systems. As long as the volume of information carried in such a manual system is low, it appears to be adequate. However, as student enrollment and professional staff has grown, increasingly scarce financial resources have caused administrators to demand better financial and operating information than the manual procedures could provide.[2] As

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[1]-----------, College and University Business Administration, Washington: American Council on Education, Revised 1968.

[2]Lawrence, Ben, and Gulko, Warren W., "A National Effort to Improve Higher Education Management", Journal of Educational Data Processing, Vol. 9, 1971.

discussed in the previous chapters, the present rapid development of computerized management systems is apparently based upon the value of this improved information.

The following sections will discuss some of the computer systems approaches to providing management information in higher education.

The Traditional Sub-system Approach

A sub-system may be either a part of an information system or a part of an organizational system. In spite of the limitations of this design approach discussed in Chapter II, there is still much work being done using this model.

Even though the computers of today have the ability to link together several related sub-systems to form a more effective information system, there are many sub-systems which have not been greatly modified or improved since they were first put on the computer...perhaps ten years ago. The computer center technicians on many campuses may lack the time and/or the ability to re-design some sub-system applications, even though they may have new equipment that is capable of handling the improvements. In some cases political reasons prevent the development of more sophisticated approaches to systems design. For whatever the reason, the literature each year contains many reports relating to new or improved sub-systems, some of which are in themselves quite sophisticated.

An example of this approach to systems design is the payroll system now in use at the University of Massachusetts. The system, which was reported in 1972, is a complex payroll disbursement and distribution system which also builds personnel pay records that may be accessed on-line through television-like inquiry terminals.[3]

Much work is still being done to develop and improve student registration and class scheduling systems. Prior to 1964 two sophisticated student scheduling systems (one by IBM and the other by Dr. G. E. Anderson) were available for use on very large scale computers (IBM 7070 or 7090). Other systems, such as SOCRATES[4] and SURE (Simplified University Registration),[5] were developed during the next few years to run on small- scale computers... thereby making computerized registration available to smaller institutions. Although the mathematical assignment routines were sophisticated, these early systems

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[3]Los, Thaddeus J., Jr., "Personnel/Payroll System", Proceedings, College and University Machine Records Conference, 1972, p. 459.

[4]Wilkes, C. F., SOCRATES Student Scheduling System, 1964 (mimeo)

[5]Anderson, G. Ernest, SURE: Simplified University Registration by Computer, General Learning Corporation, Washington, D. C., 1969.

used punched (or scanned) card input for student course requests.

New card-oriented systems have been reported by Overturf[6] and Karabinus[7] in 1972, and by Lacey[8] in 1974. These systems have been customized for their particular institutions and all contain significant improvements over earlier models in terms of the efficiency of the computer assignment algorithms. The Overturf system at Colorado State University has the ability to consider alternate course requests during the initial class assignment run for each student. Substantial systems improvements were made in the system reported by Merhar in 1973.[9] This system allows pre-registration via optically-scanned sheets and allows on-line television computer terminal (CRT) inquiry of the registration files. The report

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[6]Overturf, Leonard L., and Fastman, Jerry, "Student Generated Section, Course and Alternate Requests as the Keystone of a Computer Based, Student Responsive Advance Registration and Scheduling System", Proceedings, College and University Machine Records Conference, 1972, p. 167.

[7]Karabinus, Robert A., and Boris, Richard, "Registration and Scheduling at NIU", Proceedings, College and University Machine Records Conference, 1972, p. 181.

[8]Lacey, Robert A., and Bray, Elliot, "Automated Registration System", Proceedings, College and University Machine Records Conference, 1974, p. 320.

[9]Merhar, Richard L., "Responsive Registration and Scheduling System at the University of Pennsylvania, Proceedings, College and University Machine Records Conference, 1974, p. 320.

provides an exceptionally clear flow-chart of the assignment algorithm. The even more sophisticated system at Central State University (Oklahoma City) ties-in student advising with on-line CRT computer terminal registration and class scheduling. Course limits can be adjusted during the registration process using an on-line terminal. Student schedules and tuition bills are printed immediately upon registration by an on-line printer terminal.[10]

An on-line alumni records system which uses a CRT-terminal file inquiry device has been set-up at Texas A & M.[11] This system uses a dictionary-chain access method in order to permit the file to be searched for many possible classifications of alumni (for instance, all female 31-year old married alumni living in a certain suburb of Dallas). In another development, Ohio State has installed an alumni system which uses both microfilm and a computer to provide extensive alumni information.[12] The great bulk of stable alumni documentation is kept in large

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[10] Jenkins, William, "Continuous Advisement and Registration System", College and University Machine Records Conference, 1973, p. 171.

[11] Hedderman, C. William, "On-Line Alumni Record Keeping", Proceedings, College and University Machine Records Conference, 1972, p. 406.

[12] Miller, James R., "Alumni Information Management, A Sophisticated Marketing Approach, Using Microfilm and Computer", Proceedings, College and University Machine Records Conference, 1972, p. 489.

microfilm files that may be quickly accessed by electronic code scan. A smaller amount of variable alumni information is kept in cross-referenced computer files which may be searched for many different alumni relationships.

Both admissions and student counseling are also being assisted by computers. Both Super[13] at Columbia and DuPree[14] at Northeast Louisiana University have recently described new student counseling systems at their institutions. Both systems tie the counselor to a computer data file of each student's courses and grades in order to assist the counselor in advising future course selection. The University of Utah has developed an on-line admissions system which features CRT terminal display of all admission data and input of all application data. The computer controls all records received and automatically prints reminder memos to students to submit such data as test scores. It also makes the undergraduate admissions decision based on pre-set criteria, and prints the letter of admission or rejection.[15]

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[13]Super, Donald E., Computer-Assisted Counseling, Teachers College Press, Columbia University, N.Y., 1970.

[14]DuPree, Daniel E., and Kapp, John P., "A Student Counseling and Information Management System", AEDS Monitor, November 1973, p. 5.

[15]Whiting, Carvel, and Cook, Arvin, "On-Line Admissions System", Proceedings, College and University Machine Records Conference, 1972, p. 430.

Planning Models- The Simulation Approach

For the purposes of this paper, the broad field of computer planning models will be divided into three classes: Resource Allocation Models, Mathematical Models, and Planning-Programming-Budgeting Systems (PPBS).

Resource allocation (or cost simulation) models. These relate the resources required to the various inputs of the educational process. Enrollment projections are translated into demands for courses, faculty and other resources. Costs of these resources are reported at many levels in a school system. These models attempt to predict the effects of changes in student enrollment or other factors on resources required. Among the several models that have been introduced are CAMPUS, RRPM, SEARCH and HELP/PLANTRAN.

CAMPUS was developed at the University of Toronto[16] under the direction of Dr. Richard Judy. A concise description of the CAMPUS model is given by Schroeder.[17]

> "From enrollment inputs, CAMPUS develops activity workloads and the associated faculty, space and equipment required. Usually an

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[16] Judy, Richard W., "Systems Analysis for Efficient Resource Allocation in Higher Education: a Report on the Development and Implementation of CAMPUS techniques", M.I.S.: Development and Use in Higher Education, WICHE, Boulder, Colorado, 1969.

[17] Schroeder, Roger G., "A Survey of Management Science in University Operations", Management Science, Vol. 19, No. 8, April 1973, p. 898.

> activity is taken to be an individual course, although it may be defined at higher level. From given enrollments, students are allocated among curriculums according to a specified distribution vector. This provides a given number of students for each curriculum. Activity loads are then computed from specified probabilities that a student in a given curriculum will engage in a particular activity. These activity loads are then aggregated across all curriculums and appropriate activities are grouped by cost centers (usually academic departments) and by programs. After applying resource factors to the activity loads, the result is the resource requirements of the given input enrollments over future periods."

The first four versions of CAMPUS were experimental or specialized applications. CAMPUS V is a simulation routine which requires the custom programming of input/output routines by the purchaser. CAMPUS VI and VII are time-sharing versions of CAMPUS V. In addition to the purchase price, these models require extensive custom programming and input data preparation. CAMPUS has been tested at many institutions with mixed results.[18] Schroeder indicates that its use as an on-going management tool has so far been limited.[19]

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[18] Levine, J. B., and Mowbray, George, "The Development and Implementation of CAMPUS: a Computer Based Planning and Budgeting System for Universities and Colleges", Educational Technology, May, 1971.

[19] Schroeder, op. cit., p. 899.

RRPM (Resource Requirements Prediction Model) has been developed by the National Center for Higher Education Management Systems (NCHEMS) at the Western Interstate Center for Higher Education (WICHE), Boulder, Colorado. According to Schroeder, RRPM is more aggregated than CAMPUS. Its input formats are also not as flexible as CAMPUS.

> "In general the RRPM model proceeds from enrollment projections to course demands to faculty requirements to faculty costs and related support costs. For each time period and each degree major, student enrollment is an input by grade level. A second input is a set of matrices of student demands for each type of course or the so called Induced Course Load Matrix (ICLM). ...The result is the student demand for instruction in each discipline and course level. Faculty requirements are then generated by applying average faculty teaching load levels. These requirements are finally costed by applying unit cost factors."[20]

RRPM is more fully developed than CAMPUS and therefore requires less custom programming. RRPM costs between $10,000 and $40,000 to implement in a given school. These costs include a fee for the programs and data gathering costs. They vary depending on institution size and data complexity. Although Gulko[21] estimates the accuracy of

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[20] Gulko, Warren W., and Hussain, K.M., Resource Requirements Prediction Model (RRPM -1)--an Introduction to the Model, National Center for Higher Education Management Systems, WICHE, Boulder, Colorado, 1971, p. 15.

[21] Ibid., p. 26.

RRPM to within 5%-10% of actual costs for a discipline, a study by Jewett and others[22] at Humbolt State College (Calif.) showed a variation of as much as 40% in these figures. In 1971, a controversial paper was presented by Hopkins[23] that observed that "these models are suitable mainly for making cost-per-student calculations under current operating conditions and that it is questionable whether the expense of building in a large amount of detail for this purpose can be justified."

Other writers who have presented evaluations of NCHEMS models (RRPM, Cost Estimation, MICRO-U) are Weathersby[24], Huff[25], and Hornfischer[26]. Another important contribution

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[22] Jewett, Frank I., et al., The Feasibility of Analytic Models for Academic Planning: A Preliminary Analysis of Seven Quarters of Observations on the Induced Course Load Matrix , California State Colleges, September, 1972, p. 133.

[23] Hopkins, David S.P., "On the Use of Large-Scale Simulation Models for University Planning", Review of Educational Research, Vol. 41, No. 5, December, 1971, p. 467-478.

[24] Weathersby, George B., Educational Planning and Decision Making: The Use of Decision and Control Analysis, Ford Foundation Program for Research in University Administration, University of California, Berkeley, California, 1970.

[25] Huff, Robert A., Overview of the Cost Estimation Model, National Center for Higher Educational Management Systems at WICHE, Boulder, Colorado, 1971.

[26] Hornfischer, David R., "MICRO-U for Amherst College", Proceedings, College & University Machine Records Conference, 1972, p. 113.

of NCHEMS is the Program Classification Structure[27] which provides a standard framework for the classification of data about colleges and universities.

SEARCH and HELP/PLANTRAN are among several other operational planning models in the field. SEARCH is a time-sharing model that is sold by the consulting firm of Peat, Marwick, Mitchell and Co. Its structure is similar to that of RRPM. HELP/PLANTRAN was developed by Midwest Research Institute. Both these models are designed for use with smaller institutions.[28]

Mathematical Models. This general classification includes both deterministic and probabilistic models in the field of higher education. These models include some basic routines that were combined to form the resource allocation models discussed in the previous section. Much research has been done in this field, and there are hundreds of articles on the subject in the literature. However, since these models do not in themselves consist of management systems, an in-depth study of them is outside the scope of this paper. For those who are interested in further information in this field, a

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[27] Gulko, Warren W., Program Classification Structure, Planning and Management Systems Division, WICHE, Boulder, Colorado, 1970.

[28] Schroeder, op. cit., p. 900.

recent study by Wartgow[29] summarizes some of the work in the field and contains bibliographical notes for further reference. Anderson[30] also documents a set of typical models in the field. An extensive survey is presented by McNamara in "Mathematical Programming Models in Educational Planning."[31] Much work is continuing in this area as further discussed in Plourde's[32] review of current useage.

Planning, Programming and Budgeting System (PPBS)

A PPBS is series of inter-related manual and computerized procedures which are designed to formalize and improve decision-making in higher education. The system involves the setting of definitive organizational goals and objectives. Educational programs are identified and

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[29] Wartgow, Jerome F., An Assessment of the Utilization of Computer Simulation Models in the Administration of Higher Education, a doctoral dissertation, University of Denver, 1972.

[30] Anderson, G. Ernest, Jr., Simulation Models for Developing an Individualized Performance Criterion Learning Situation, Center for Educational Research, School of Education, University of Massachusetts, Amherst, Mass, 1973.

[31] McNamara, James F., "Mathematical Programming Models in Educational Planning," Review of Educational Research, Vol. 41, No. 5, December, 1971.

[32] Plourde, Paul J., Experience with Analytical Models in Higher Education Management, Center for Educational Management Studies, University of Massachusetts, Amherst, 1976.

evaluated in terms of the goals/objectives. Budgets are developed which will support the approved programs on a continuing basis. A major part of the system is a cost effectiveness evaluation of programs, with consideration of alternatives.[33] Computerized mathematical models are used to develop a series of budgets which can assist the planner in making decisions concerning input variables. The cost-effectiveness of various competing programs may thus be better compared. Most higher educational outputs are placed into three major catagories: instruction, research and public service. Based on this high-level similarity of output goals or catagories, the standard Program Classification Structure has been developed,[34] so that institutions may be able to compare costs of programs. It is thus hoped that the results will be improved comparability of data in institutional, regional and national planning.

There is a large body of literature on PPBS in higher education. Nelson's bibliography on the subject[35] contains

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[33] Weathersby, George B., and Balderston, Frederick E., PPBS in Higher Education Planning and Management, Ford Foundation Program for Research in University Administration, University of California, Berkeley, Calif., 1972.

[34] Gulko, Program Classfication Structure, op. cit.

[35] Nelson, William C., PPBS for Educators, Vol. IV: A Research Bibliography Final Report, Ohio State University, Report-Bilb-4, March 1970.

over 1,000 entries. In spite of the fact that many institutions are attempting to implement a PPBS, there have been many difficulties encountered. One of the problems is that the system is difficult to integrate within existing university operating and financial control systems. Another is the necessity to find some measure of the outputs or benefits of educational programs. Since such outputs cannot yet be accurately measured, this limits the effectiveness of a PPBS.[36] In his parting address as President of the AAUP, Walter Adams expressed some of the frustration with the system.

> "In practice, however, PPBS often yields baneful results, especially in an academic setting. First, PPBS tends to become a mechanical adjunct of bureaucratic administrators and frustrated legislators. In the welter of PPBS data, it is not always easy to remember the goals of a university. ...In short, a university makes a product radically different from that which management experts are accustomed to deal with. Second, by measuring that which is measurable, whether or not it is important, the managerial cost-benefit approach often yields spurious accuracy and misleading data."[37]

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[36] Sisson, Roger L., Brewin, C. Edwin Jr. and Renshaw, Banjamin H., "An Educational-Planning-Programming-Budgeting System", Educational Technology, Feb., 1972.

[37] Adams, Walter, "The State of Higher Education, Myths and Realities", AAUP Bulletin, June, 1974, p. 124.

The "Total System" Approach to Management Information

As computers became more powerful and operating systems became available which enabled more effective use of peripheral equipment (such as printers, card readers and disc files), systems designers began to consider the relationships in the data requirements between different sections in an organization. Computer people, who were anxious to increase the use of their machines, began to modify existing programs in the computer to join two or three sub-systems (such as purchasing/accounts payable and scheduling/registration).[38] By the mid-1960's, the design of discrete sub-system computer applications had become less interesting. The leaders in the computer world were talking about "total systems." The term "management information system" had also come into vogue, although few people in management knew what an "information system" was.

A "total system" is simply a system which integrates all logically related sub-systems in an operation or organization in order to develop summary reports of the related operations which are of greater use in management

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[38] An excellent example of this approach is presented in IBM College and University Administrative Application, IBM Technical Publications Dept., White Plains, N.Y., No. E20-0149-0, 1964.

decision-making. Many colleges and universities developed such systems and many are still in use.[39,40,41] RRPM is a "total system" linking together several computerized mathematical models. Other "total systems" on campus today are those which combine on the computer application processing, admissions, registration, billing, grade recording and student records. Systems were developed which linked payroll, labor cost distribution, governmental reports, personnel records and general accounting. This integrated approach to systems design is still very much in use, but new technology has now lead to the development of a "better" design model.

As technological development of computers continued into the 1970's, administrators encouraged further linking of information relating to sub-systems and organizational components. The main reason for this data unification was to enable the "unified administrative control of the

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[39] Tonks, Jesse W., "General Education Management System," AEDS Journal, Vol. 3, No. 3, March, 1970.

[40] Benson, Robert J., "Innovations in Financial Information Systems Design," Proceedings, College and University Machine Records Conference, 1973, p. 348.

[41] Bellott, Fred K., and Bliss, Sam W., A Small College Information System, Memphis State University, 1972.

university."[42] The trend toward administrative centralization based on computerized management controls is well under way. Figures 3-1 and 3-2, on the following pages, illustrate data useage and data files as related to organizational levels.

Data Base Management Systems

The term "data base" implies another major development in information systems design. This topic was briefly introduced in Chapter 2, and will be expanded here. Those who tried to implement the "Management Information System" (MIS) of the late 1960's sometimes used decision-analysis techniques in order to evaluate the information required by people at different levels and positions in a an organization. However, they found that people tended to move about in an organization, and the management styles of new incumbents required changes in the information provided. The highly complex information files that had been linked to build the MIS tended to resist such changes, causing time delays and excessive costs... as well as frustrated users of the information.

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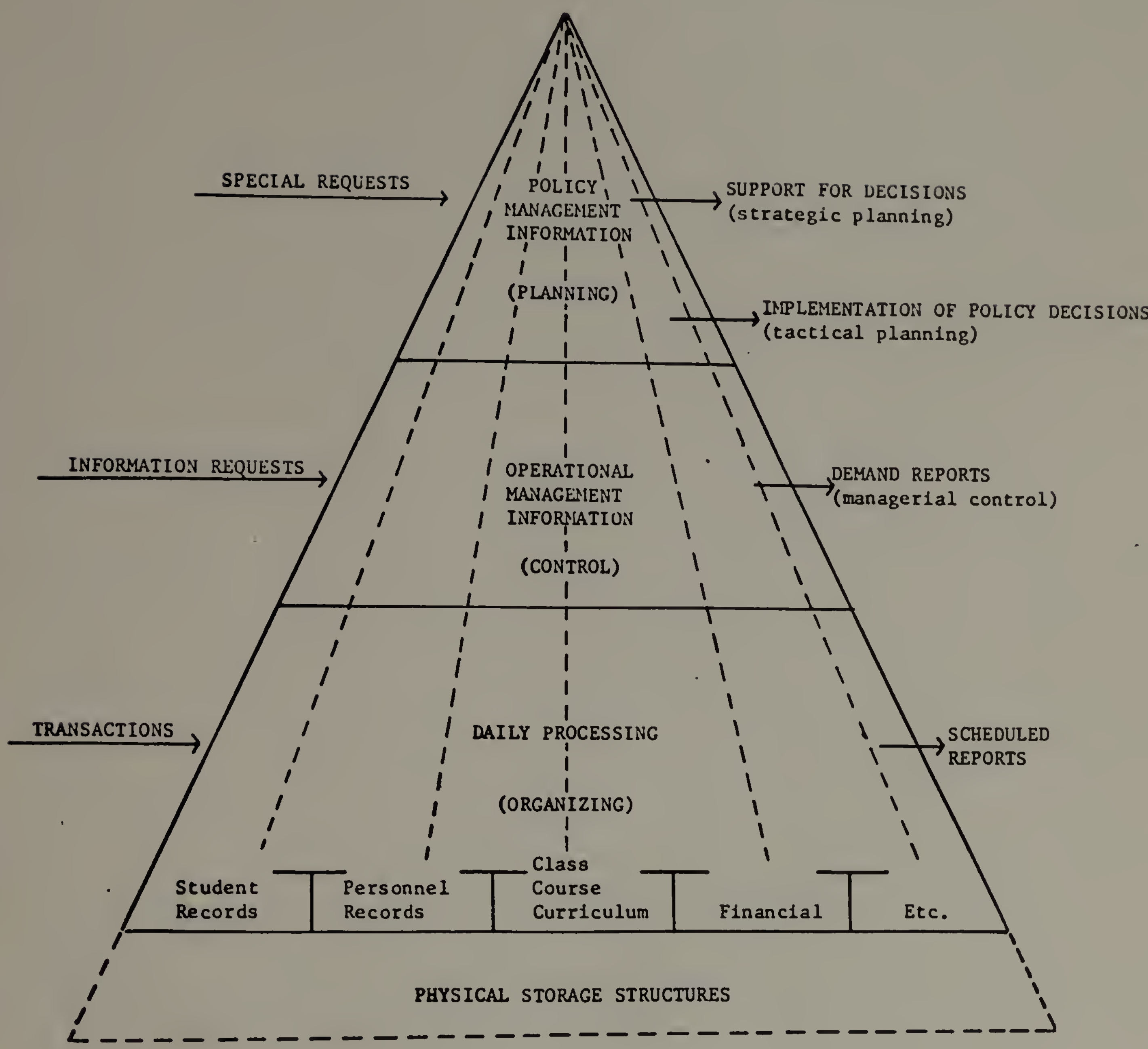
[42] Catrambone, Joseph A., "Consolidation of Administrative Data Processing at the University of Illinois," Proceedings, College and University Machine Records Conference, 1974, p. 156.

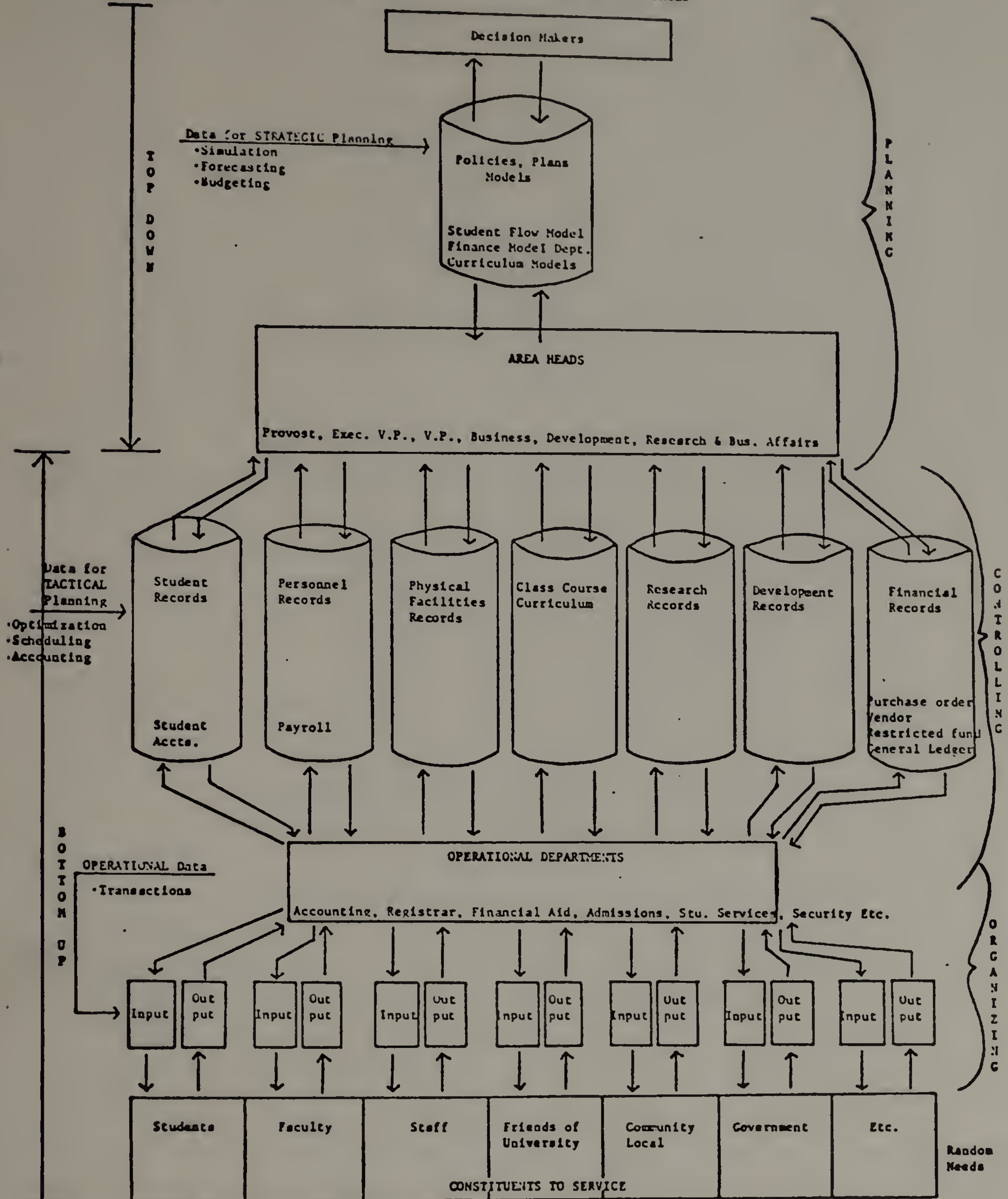
Figure 3 - 1

LEVELS OF INFORMATION



Source: Mossmann, Charles, <u>Academic Computers in Service</u>, Jossey-Bass, San Francisco, 1973.
(Reprinted with permission of publisher)

Figure 3 - 2. ADMINISTRATIVE INFORMATION FLOW AND DATA BASES



Source: Mossmann, Charles, Academic Computers in Service, Jossey-Bass, San Francisco, 1973. (Reprinted with permission of publisher)

Several major efforts were undertaken to develop more flexible file-linking techniques.[43] This effort, plus improvements in computer memory size, random access storage, computer control programs (operating systems) and telephone communication links combined to provide a major new approach to systems design: the Data Base System. While many data base systems simply provide flexible (and extremely complex) linkages between existing data files in a system, the present trend (discussed in subsequent sections of this chapter) is to re-design and integrate the data files themselves.

A "data management system" has been defined as:

> "A user-oriented generalized software package which performs functions related to file definition, creation, interrogation and maintenance. It is independent of any specific application. It allows the user to access data ... without being concerned about how the data is stored physically ...It is a totally integrated system, with all of the files cross-referenced and interrelated to form a complete data base which can be referenced in numerous different ways."[44]

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[43] Koehr, G.J., Connolly, J.T., Rhymer, P.P., Gerken, B.L., and Sahr, E.V., Data Management Systems Catalog, The MITRE Corporation, Bedford, Mass., 1973.

[44] Madill, J.P., and Kuss, J.K., "Techniques for Evaluation of Generalized Data Management Systems," Proceedings, College and University Machine Records Conference, 1972, p. 20.

According to Walsh, "management information systems depend on a data base management system for building, restructuring and accessing information from the data base. It is worth noting at this point that this data base management system can be a manual system, but with large volumes of data it is usually an automated system."[45] In the computer systems profession, innovation is rewarded with both prestige and better job offers. Therefore it should not be surprising to observe that more than 100 different data base management systems have been developed during the last 7 years. Most of these systems are oriented toward a particular field or industry. They may also be specialized in terms of computer brand, size or configuration. Many generalized DBM systems are commercially available. We shall briefly review some of the characteristics of those few that are widely used in the field of higher education.[46]

OASIS (on-line administrative information system) is a limited early attempt at a DBMS that was developed at

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[45] Walsh, R. Brian, "Data Base, The Concept, The Committment", from CAUSE, 1973, p. 216.

[46] Shoemaker, W.A., "Overview of Management Systems for Higher Education", College Management, 9, April, 1974, p. 12-14.

Stanford University in 1968. The system linked several major files on a medium scale computer system. Records within each file were linked in various patterns with a random-access search method called "chaining".[47] The original system was not too successful. The OASIS System has been modified several times and recently has been adapted to a personnel and student records system at the University of Vermont. It was chosen because it was less costly than competing systems and was adequate for the needs of a partial system on a 10,000 student campus.[48]

IMS (Information Management System) was developed by IBM as a package of related computer programs which can be adapted by the user (using the COBOL language) to his individual applications. The IMS package modifies the files of the user into an integrated data base system that features cross-linking between different files. Logical file records are organized by IMS into a hierarchy of related information. A data dictionary is used to locate major items of data in the files, and a chaining method is used to provide direct access to related fixed or variable-length sub-records in the hierarchy. (A brief

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[47] Lauzon, Roger C., "OS-OASIS Conversion", CAUSE, 1973, p. 557.

[48] Sire, Paul W., "On-Line Administrative Information Systems: A Case Study," Proceeding, College and University Machine Records Conference, 1974, p. 194.

discussion of record access methods will be presented in a subsequent section of this chapter.) IMS is leased by IBM for about $20,000 per year, including on-line access programs. It is one of the earliest complete systems developed, and is installed in over 800 locations in the U.S., including many colleges and universities. IMS requires a rather large computer memory (90-350K).[49]

TOTAL is another much-used data base management system (over 1200 users). It is designed to be used with small computers made by IBM, Univac, Honeywell and others. It is a "host language" data management system that provides data retrieval and data maintenance functions. The "host language" refers to the applications program language used by the buyer (most often COBOL). All printed output is provided by the facilities of the host programming language (and is not a part of the TOTAL package). TOTAL stores all data files in fixed-length record form on random-access storage devices. Records in different files can be associated by storing a link between common fields of each data record in each file.[50] The sale price of

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[49] Ryland, Jane N., and Donald, A. Wayne, "IMS/360 in a University Environment", Proceedings, College and University Machine Records Conference, 1972, p. 237.

[50] Plourde, Paul J., "TOTAL", from Millard, R., ed., Planning and Management Practices in Higher Education, Denver, Education Commission of the States, 1972.

TOTAL is $27,000-$35,000. TOTAL may be used on computers with less than 35K memory storage.[51]

IDS (Integrated Data Store) was developed in the late 1960's by the General Electric Company for its series 600 computers. These computers (and IDS) are now maintained by Honeywell, Inc. About 100 firms use IDS, mostly industrial users. The system is related to the COBOL programming language, in that the data structures are modified from the COBOL data division of the user's application programs. The IDS system develops a series of data files that utilize multiple levels of chaining to access data. The data record is fixed-length and contains record identifiers, data fields and a series of chain pointers (which point to the next record in the logical sequence of the chain). The IDS system is provided free of charge to Honeywell 600/6000 users. It requires a large computer memory (50-250K). IDS is not much used by colleges and universities.

SYSTEM 2000 is a powerful DBMS that is sold by MRI Systems of Austin, Texas. The installed price ranges between $35-130,000. Over 60 systems have been installed.

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[51]____________, TOTAL, The Data Base Management System, CINCOM Systems, Inc., Washington, D.C., 1970.

It is available on IBM, Univac and CDC computers, and requires a medium-scale computer memory (minimum 130K). It formats user records from COBOL statements, and sets up random-access files using a sophisticated inverted-file dictionary and chaining between logical records.[52]

There are at least seven other generalized DBMS systems that are available commercially to users of different makes and sizes of computers. They are too new to be widely used in higher education. Please see the chart on the following page.

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[52]___________, System 2000, MRI Systems Corporation, Austin, Texas, 1972.

TABLE 3 Comparison of Commercial Data Base Management Systems

System	Vendor	Equipment	Core Required (Bytes)	Number of U.S. Installations	Purchase Price
IMS-II, IMS-DC IMS/VS	IBM	IBM 360/370	90K - 350K	400	$550 - $1,550/mo Lease only
TOTAL	Cincom Systems Cincinnati, Ohio	IBM 360/370 H200/2000 Univac 70	8K - 35K	400	$26,500 - $34,500
System 2000	MRI Systems Austin, Texas	IBM 360/370 Univac 1100 CDC 6000/Cyber 70	130K	60	$35,000 - $130,000
Adabas	Software AG Reston, Va.	IBM 360/370 Univac 70	110K	25	$120,000
IDMS	Cullinane Boston	IBM 360/370 Univac 70	50K - 65K	10	$30,000
Metabase	PMI New York	IBM 360/370	50K - 75K	10	$28,000 - $72,000
IDS	Honeywell	H6000	50K - 240K	100	Bundled
DMS	Xerox	Sigma 5, 6, 7, 8, 9	35K	35	Bundled
DMS/1100	Univac	Univac 1100	60K	25	Bundled
DMS/6700	Burroughs	6700, 7700	150K	10	$70,000 - $100,000
DBMS/10	DEC	Decsystem-10	32K - 80K	10	$15,000

Chart describes some of the data base management systems available.

Source: Computerworld, Feb. 27, 1974

The State of the Art in Higher Educational Management Systems

This section will consider some of the most recent relevant developments in higher educational management systems in an effort to discern trends that are being established.

System penetration. A recent survey of computerized management information systems in higher education was made by R.L. Mann.[53] According to this survey, 69% of the 430 institutions reporting indicated that they were planning or currently implementing a computerized MIS. Another 16% indicated that they will definitely develop such an MIS in the future. Only 15% indicated that they had decided against an MIS. The largest schools (which tend to lead in other innovations) dominated the group that is now implementing an MIS. The survey indicated that these projects are usually initiated by the top-level central administrative group, and that the main focus of information provided by the systems would be toward this central administration. Support to be provided to student or faculty groups is negligible. Over 50% of the respondents indicated that the purpose of the MIS

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[53] Mann, Richard L., "National Survey of Computer Based MIS in Higher Education," CAUSE, 1973, p. 663.

development was to provide for greater centralization of decision-making. The WICHE/NCHEMS Data Element Dictionary was reported being used by 36% of those responding.

<u>New developments in systems design</u>. In December 1974, Paul J. Plourde presented a paper which summarized the most recent developments in Management Information System (MIS) design. The elusive nature of the MIS was described in terms of the extremely complex technical and organizational problems related to the concept. The idea of fully integrated MIS is over ten years old. However, the concept still has not been implemented at a level that reaches its full potential. The fact that an MIS must be fully imbedded in the basic information flows of an organization presents a systems analysis and design problem that has not yet been solved. Since the organization cannot be "frozen" while an MIS is designed and implemented, systems designers have turned to the computer itself to provide the flexibility needed to permit the design of systems that were flexible enough to match the changing organization. This approach may seem ludicrous, since many users are aware that a fully programmed computer system is only flexible within very narrowly (and carefully) defined limits. Therefore, the major thrust of new developments at this time and in the near future will continue to be into areas that broaden the flexibility of computerized

systems.[54]

Such developments themselves depend on continued improvements in the training of systems designers, management awareness of potential benefits, computer hardware and operating systems capabilities (and cost/benefit ratios), and progress toward a viable theory of information.

Technology: Hardware and software developments. Machine improvements that relate to the problems of higher education systems are extremely complex, and will therefore be presented here in summary form. The masses of data that must be available to the computer in an educational data base require the continued development of very large on-line file capabilities that have fast access times and low cost per item stored. Disc files are presently used for these functions. Operating characteristics of these files continue to improve; today 50 million characters of information can be stored on-line at a cost that is less than the cost of 10 million characters only a few years ago. By 1976, the standard design-size of disc file storage devices for large computers was 300 million characters of data, any group of which was available to the computer in about

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[54] Plourde, Paul J., "A Generalized Systems Approach to MIS Design," Proceedings, CAUSE National Conference, 1974.

one-fifteenth of a second.[55] In large computers, microprograms that are readily switched will permit a greater degree of program flexibility in the development of customized educational applications, such as computer assisted instruction (CAI).

According to Blackwell, there is much potential for the use of mini-computers in higher education. The costs of these machines is favorable, and their capability is growing as memory is expanded and better software is developed.

> "The present speed of mini-computers -- up to one million operations per second -- is adequate for most applications. The present limited memory, usually a few thousand words, may be a handicap. The rapidly decreasing cost of high-speed memory will remedy this deficiency. The input-output problem can be solved through the use of inexpensive cassettes that contain both programs and data. Standardization should be achieved in the next few years.
>
> "The success of computer timesharing in the late 1960's created a demand for low-cost, reliable terminals. The adaptation of familiar communication devices -- typewriter, teletype, television, and telephone -- for computer terminals is an obvious trend. ...The use of a limited vocabulary in spoken computer input, although technically possible in certain situations today, will probably not be widespread by 1980."[56]

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55 ___________, "Large-capacity Discs Now Standard," Computerworld, June 15, 1976, p. 2.

56 Blackwell, F.W., "The Probable State of Computer Technology by 1980," Journal of Educational Data Processing, Vol. 9, No. 1-2, 1971, p. 13.

Blackwell indicates that computer assisted instruction will grow rapidly during this decade, after a slow start. The time-sharing techniques that made the idea possible are only now being perfected and made cost-competitive with conventional teaching.

New software programs are continuing to make the computer more effective in higher education. A technical development of the late 1960's in the area of linking detail computer records within dis-similar files[57] provides the basis for much of today's development of Data Base Management Systems. Most of the present DBMS now available depend on some type of data linking. Continued improvements in software in the areas of multiple (parallel) processing of computer programs and in building more effective data base management systems may be expected, as computer hardware capabilities (and memory capacity) expand.

The trend toward regional networks of computers has already begun in Illinois, California and other regions. This trend will continue, as inter-computer communications improve and the related costs decrease. Lower communications costs (perhaps through increased use of special-

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[57] For an excellent discussion of this, see Dodd, George G., "Elements of Data Management Systems," Computing Surveys, Association for Computing Machinery, Baltimore, Maryland, June, 1969.

purpose data communications lines) will place computerized systems within the reach of nearly all schools. This may increase the use of Computer Assisted Instruction and computerized educational management tools (if related political and organizational problems can be solved).[58] An interesting example of regional computer useage is provided by the project at Empire State College (New York). This institution uses computers to control student and teacher activities in a great variety of educational programs that are being offered at many non-traditional locations throughout the state.[59] However, a recent article by Chaney, Lawrence and Orwig indicates that the trend toward large networks of computer systems may be contributing to an increased burden of complexity in data systems and increased problems with the compatability of data from many different institutions.[60]

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[58] Blackwell, _op_. _cit_., p. 16.

[59] Butler, Joseph E., "Computer Off Campus: With Strings Attached," _Infosystems_, November, 1972, p. 40.

[60] Chany, John; Lawrence, Ben; and Orwig, Melsin, "Information and Analysis in the Context of Institutional/State Relationships: The Tie that Divides Us," _NCHEMS National Assembly Proceedings_, Boulder, Colorado, 1976, p. 61.

Mathematical models in higher education are continuing to be developed and perfected. Ageloff[61] and others have recently attempted to apply probabilistic techniques to such deterministic models as RRPM. Huff[62] reports on the development of RRPM-1.6, which adds indirect cost analysis capabilities to the basic RRPM to produce historical full-cost results. Johnstone's current bibliography of recent model developments contains 125 entries.[63] A model of particular interest to middle-level educational managers is specialized in the area of academic departmental decisions. This was developed for implementation in the Graduate School of Management of UCLA.[64] This model concerns itself with the allocation of faculty effort in the areas of teaching, departmental service, research,

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[61] Ageloff, Roy, An Analysis and Extension of the Resource Requirement Prediction Model, Doctoral Dissertation, University of Massachusetts, Amherst, Mass., 1975.

[62] Huff, Robert A., and Young, Michael E., RRPM-1.6 Application, National Center for Higher Education Management Systems at WICHE, Boulder, Colorado, 1973.

[63] Johnstone, James N., "Mathematical Models Developed for use in Educational Planning: A Review," Review of Educational Research, Vol. 44, No. 2, Spring, 1974.

[64] Geoffrion, A.M., Dyer, J.S., and Feinberg, A., Academic Departmental Management: An Application of an Interactive Multi-Criterion Optimization Approach, University of California Research Directorate, Oct., 1971.

counseling, committee work and service. The model focuses on the "inputs" of the educational process, since quantifiable measures of outputs are not available. Chew's[65] cost simulation model of a university graduate school is another interesting recent development. In another relevant article, Westhersby and Weinstein[66] discuss the use of the CAMPUS model to provide departmental information and planning assistance. They also present an excellent comparison of many models, including CONNECT/ CAMPUS (which is a very detailed resource-costing model that is oriented toward the instruction of decision analysts). In spite of continued development in the area of mathematical models, a recent study by Plourde indicates that the models still find only limited practical use in universities and colleges.[67]

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[65] Chew, Robert L., A Simulation Model for Graduate Education Planning in the University, Center for Educational Management Studies, University of Massachusetts, Amherst, 1976.

[66] Weathersby, George B., and Weinstein, Milton C., A Structural Comparison of Analytical Models for University Planning , University of California Research Directorate, August, 1970.

[67] Plourde, Paul J., "Institutional Use of Models: Hope or Continued Frustration?", in New Directions for Institutional Research, 9, Spring, 1976.

The Trend Towards the Humanization of Systems

The recognition of the potential de-humanizing effect of computer systems used in higher education has perhaps resulted in the beginnings of a more humanly-responsive approach to systems design. Such a trend can be discerned in the increased interest in protecting the privacy of information about individuals that is kept on computer files. One new system uses television-like CRT terminals during counseling sessions with students in order to provide rapid access to complete and current background materials, including latest grades.[68] This is an application at a Community College near Kansas City which does all its data processing through off-campus service bureaus.

One of the best examples of a humanized information system on computers was reported by the Director of Admissions at Syracuse University. This is an on-line admissions system which is designed to "maintain the integrity of student data flow from admissions inquiry through graduation or withdrawal." The system permits

[68] Elliot, Tom, "Service - A New Approach to Educational Data Processing," Proceedings, College and University Machine Records Conference, 1973, p. 208.

continuous registration in mini-courses within a flexible multiple-program curriculum. According to the article,

> "Technical sophistication has played and will continue to play a secondary role to expediency, flexibility, humane service to the student and administrative and political reality."[69]

This admirable trend has been recognized by Sterling in a recent article in the Communications magazine of the Association for Computing Machinery. This article discusses several recent projects on the humanization of an organization, and recommends guidelines for further effort.[70]

Summary

This chapter has reviewed some of the literature relating to existing systems and major developments in the area of information systems for higher education. The trends that appear evident from the literature indicate that we have passed through several cycles of technological development to reach the present level of sophistication (complexity) in the Data Base Management

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[69] Barone, Carole A., and Benzel, Thomas F., "A Personal Approach to Admissions and Records Systems Development and Implementation," Proceedings, College and University Machine Records Conference, 1974, p. 172.

[70] Sterling, Theodore D., "Guidelines for Humanizing Computerized Information Systems," Communications of the ACM, November 1974, p. 609.

System approach.[71] The developments are exciting to the computer professional, and they hold potentially significant opportunities for higher educational administrators to improve their managerial performance. This trend should accelerate as the technology improves and the systems gain wider political acceptance on campus and in legislatures. However, university faculties might view this trend toward centralization with some concern.

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[71] For further information on these trends, see Berg, John L., ed., Data Base Directions: The Next Steps, Proceedings of the workshop of the National Bureau of Standards and the Association for Computing Machinery, Fort Lauderdale, Fla., Oct. 29-31, 1975. See also the record of the Special Interest Group of the Association for Computing Machinery: SIGMOD Record, ACM, Vol. 8, no. 4, Nov. 1976.

CHAPTER IV

OVERVIEW OF THE PROPOSED MODEL SYSTEM

Since computer systems documentation is highly technical in nature, this section will be restricted to the presentation of the overall design philosophy and a general discussion of the model system. The technical details of the proposed system are presented in the Appendix. The model system is designed to meet the administrative information needs of a smaller college (1000 to 3000 students). While there is no reason that the model cannot be expanded (or contracted) to meet different needs, this design level was chosen to respond to the pressing needs of these schools.

The system design. Traditional methods of designing a computer-based administrative information system usually began with an evaluation of reports that were then in use by administrators.[1] Meetings were held between analysts and administrators to determine additional needs or changes in reports. The data content of the new reports was then used to develop the files which would store that data for those reports. Once the files were designed, means were

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[1]See Lucas, Henry C., Jr., The Analysis, Design and Implementation of Information Systems, McGraw-Hill, New York, 1976; and also Davis, Gordon B., Computer Data Processing, McGraw-Hill, New York, 1973.

found to obtain the necessary data from the various sources. The steps taken resulted in the design of data files that were efficient in terms of the equipment limitations which had been imposed during the first two decades of computer development. Among the most stringent limitations was the high cost and limited size of computer main memory and on-line random-access data storage files.

However, equipment manufacturers have been steadily reducing the cost per character of computer main memory,[2] and for the past five years virtually unlimited mass random-access data storage has been available.[3] The recent development of Data Base Management Systems takes advantage of these technical innovations which have removed some of the major limitations in information systems design.

Design methodology. The system design approach in this model will attempt to take full advantage of technical innovations in order to expand the flexibility of computer data files and at the same time reduce their complexity. The objective is to move the inefficiencies in existing college administrative systems from the present manual operations in the human organization to those areas of the

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[2] French, Nancy, "Dynamic Growth Seen Continuing", Computerworld, Vol. X Nr. 24, June 14, 1976, p. 1.

[3] Bowers, Dan M., "Removable Disc Storage, Where It's Come From and Where It's Going", Modern Data, January, 1976, p. 17.

computer where we are experiencing the greatest continuing technological improvements.

It would seem obvious that if all the data that is used in all administrative operations for several years were to be placed in its original form on one very large computer data file, then that file could be used as a source for all summary information that is needed by administrators for that time span. Such a complete data file could then produce any different combinations of data that are needed for administrative reports. It is this view that data analysis is one of the first and most important steps in the systems design process that is different from the traditional method outlined above.[4] By designing a data file that can capture (and eventually return) any and all data that is used in an administrative information system, the problem of inflexibility is greatly reduced. The Data Base Management Ststems attempt to do this by combining or linking different existing data files into a single data source for all reports.[5] The Data Base Management System achieves its ends through a very complex

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[4]This data analysis phase in system development is discussed in a recent brochure that describes the TOTAL Data Base Management System. The brochure is available from CINCOM Systems, Inc., Washington, D.C.

[5]For a complete review of the features of Data Base Management Systems see Selection and Acquisition of Data Base Management Systems, Association for Computing Machinery, New York, 1976.

series of linking programs that develop relationships between the data items in the different files. The design model presented here overcomes this complexity through the use of one large data file that will contain all data in a system as well as the necessary identification codes to control and link dissimilar data items in the file into organized information for administrative reports.

Data File Design

Most traditionally designed data files use large data records. A less complex (and less machine-efficient) approach would be to treat each data item (such as a person's name or an address) as if it were a unique data record. This data record would be much shorter than usual, since it would contain less data. The short data record would also contain a series of control code-numbers, such as account codes, organization codes, student numbers, sequence numbers and dates. These codes would enable the information contained in the record to be easily linked to other related data as required. With each piece or small grouping of data items in a data file having its own unique control number and other necessary control codes, there is almost no limit to the types of information that may be carried on the data file. There is also no limit to the different combinations that can be made from the information. This file design concept seems to approach an optimum in data file flexibility. It has been named the "Z-File".

The Z-File is defined as a congregation of discrete short computer data records, each of which is uniquely coded, and which contain all transaction-level data in an information system.[6]

A data record in the Z-File is similar in design to the "journal voucher" that has been familiar to accountants, auditors and managers for many years. A journal voucher is a piece of paper on which an accountant writes certain variable information, such as an amount to be charged or credited to an account. (A personal bank-account check is similar to a voucher.) Also on the paper the accountant fills in certain control information, such as the transaction date, the account name or number that is to be charged, and perhaps a source reference code and a sequential control number (such as a check number).

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[6]The use of short "bucket" records was suggested by G. E. Anderson in the report titled Administrative System for the Model School Division of the District of Columbia Public Schools, General Learning Corporation, Washington, D. C., 1968.

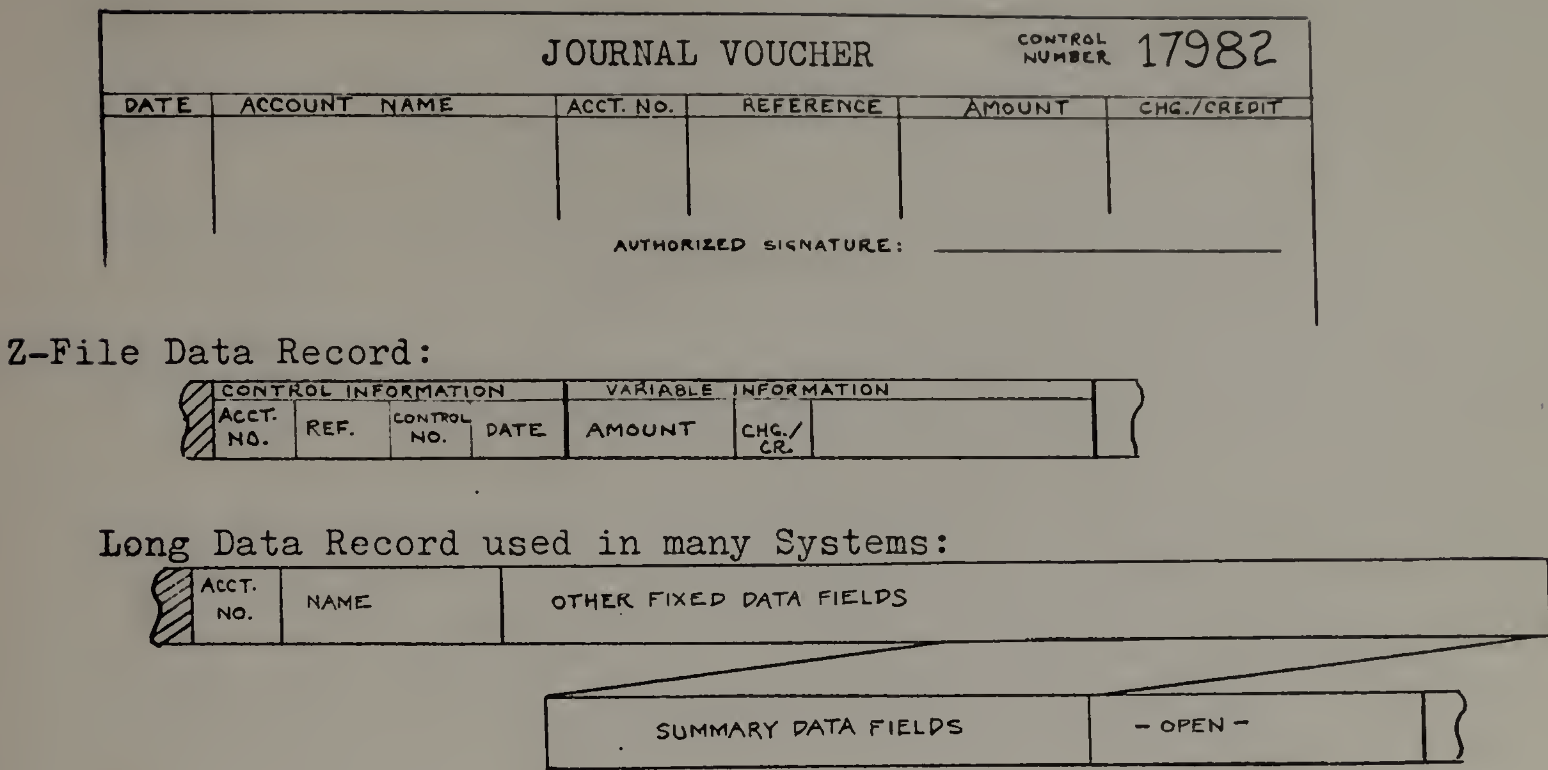

Figure 4-1 An illustrative comparison between information formats carried in different types of data files.

With the control information on the journal voucher, any other accountant with some knowledge of the operating procedures can understand what is to be done with the variable data (in this case, an amount of money). Such as journal voucher form can be placed in a file with other similar vouchers without losing its unique identity. It may even be mis-filed with dissimilar data. It can still be identified.

Traditionally, computerized administrative information systems carried most data on the files in summary form.[7] This permitted more efficient use of expensive computer storage files. Detail records (journal vouchers, checks, individual grades, et cetera) were retained only in the original hard-copy form or in boxes of punched cards that were not usually well-controlled. Much diligent searching was required to locate a given detail source of information. Extensive program and systems modifications had to be made if the detail information were to be used in the system in place of the summary information. The concept of keeping large amounts of detail information in the computer data files was in itself revolutionary, until recent reduced costs of mass data-file storage made possible Data Base Management Systems which encouraged the development of detail data files.[8] The Data Base Management Systems move in the same direction, conceptually, as does the Z-File

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[7] Relevant data file design techniques are presented in College and University Administrative Applications, IBM Data Processing Application Manual, #E20-0149-0, 1965;

also Cuozzo, D. E. and Kurtz, J. F., "Building a Base for Data Base: A Management Perspective", Datamation, October, 1973.

[8] The Data Base Management Systems usually break large file records into smaller "data elements" which may be more easily manipulated. For a discussion of this, see TOTAL, The Data Base Management System, CINCOM Systems, Inc., Washington, D.C., 1970.

model system.[9] Both systems provide increased report flexibility and increased accessibility of detailed information. The Data Base Management Systems are all expensive and very complex proprietary computer "soft-ware" routines that assist an existing computer user to convert extensive and dissimilar computer data files into a more useable and flexible format.[10] The model system for colleges that is documented in the Appendix is intended for use by the smaller institution that may have only recently begun using a computer for administrative work. Such users would not be expected to have the financial resources or the technical sophistication required for the use of a Data Base Management System, but their need for administrative information is at least as great as larger schools.

The space in the Z-File record that is available for variable data may contain any conceivable alphabetic or numeric information: an amount in dollars or any currency, a student or faculty name, an address, a partial course description, a book title, inventory information, a series of course grades, a vehicle maintenance record, and so on

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[9] ...., Selection and Acquisition of Data Base Management Systems, op. cit. Relevant design criteria discussed are "data independence" and "data non-redundancy".

[10] See cost comparison chart for Data Base Management Systems, Computerworld, op. cit. (reproduced on page 52 of this study).

without limit. A code number in the "control field" of the record clearly identifies to the computer the type of data that is in the variable field. A three-character record control field will permit 35^3 different types of data records to be carried on the Z-File. A small college would need only a few hundred different types of data in order to build a comprehensive administrative information system.

In addition to the record code, the Z-File record control field will contain other control information that is relevant to the data being carried in the record. A student name record might contain the student's Social Security or student number as control. A Z-File record that contains the title of a library book might use the library code, the book identification number (Dewey-Decimal or other), the date purchased and perhaps a publisher code. Out of an 80 character Z-File record, 17 characters are reserved for control numbers, leaving 63 characters for variable data.[11]

Fortunately for the collegiate user with limited resources, it is the costs of computer processing and data storage that have been most greatly reduced by new technology. These costs are expected to continue to decline

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[11] Anderson, G. E., op. cit., also describes similar division of data records.

in the future. According to Bowers, packing densities of data on disc files have increased 100 times in 20 years (from 10,000 to 1 million bits per inch), and that we can expect another tenfold increase by 1980.[12] Dr. Gene Amdahl predicts even greater changes:

> "More memory is going to be the biggest impacting factor of all... Technology advances will make possible enormous memories at costs comparable to those paid today for much more modest memories. The quantitative change will actually produce a qualitative change in the way data processing is done."[13]

A more detailed description of the Z-File is presented in the Appendix. However, additional file design factors are shown below in order to clarify the basic use of the file in the model system:

1. The code-field portion of each data record will contain sufficient control information to provide a clear "audit trail" for each piece of data in the Z-File. Date of entry, and even a sequential batch number of the data source can be carried in this code field. This will enable all data on the Z-File to be easily traced back to its origin for verification. This should enhance the "trustworthiness" of the data (discussed in Chapter two).

2. Basic source data on the Z-File is not to be condensed or summarized. Updating of the Z-File takes place by simply adding new data records to the existing file. The Z-File may supply information for all administrative reports that are required, but no data is to be erased from the Z-File until such time as

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[12] Bowers, op. cit.

[13] Quoted by Upton, Molly, in "Amdahl: The Man and the Mainframer", Computerworld, November 15, 1976, p. 15.

the file is purged of unneeded data (perhaps once a year). Obsolete data may be retained on less active media (magnetic tapes).

3. If any erroneous data is entered into the Z-File system it will be identified and properly controlled. Error data on the file will appear persistently on a daily "aged" error listing until it is corrected. An "audit trail" will be retained on all error corrections in the file.

4. All reports in the system are generated from a single data-source Z-File. Since there is virtually no limit to the types of data which may be on the file, there is no limit to the variety of reports that may be developed. Unforseen data that is needed on new reports may be added to the Z-File at any time without making program changes.

5. Batch reports may be generated all at once by passing the entire Z-File through a report/update program which can generate any number of reports (based on a report control matrix and standard data-extraction routines). Since each data record contains a strictly limited amount of basic data, specific demand reports (detail or summary) can be developed on a time-share basis through the use of file-inversion (specialized dictionary) techniques. More complicated file "chaining" techniques that are used in most Data Base Management Systems can be avoided.

One of the major problems encountered in systems implementation is that of time-delay. A complete new system can take more than one year between design and the first reports being produced. During this time administrators must tolerate much of their own time being taken in meetings with systems analysts and ever-increasing development costs without seeing tangible results. In the Z-File system, all data summarization and manipulation occurs in the report-printing programs. The data input-edit and the Z-File update programs are relatively uncomplicated, since all data is in standard short format and the data records are merely appended to the Z-File.[14] Many other systems depend on a complex series of linked programs to edit data, update files and develop reports. Minor system design errors often necessitate changes in several of the programs in a series. Delays caused by such problems are often incomprehensible to administrators, who then tend to lose faith in the entire system. The Z-File design philosophy allows important reports to be programmed and implemented as soon as the Z-File update program is completed. Even though most of the other reports are not yet ready, the relatively fast (2-3 months) production of a few key reports can mean the difference between success and failure of an entire new system.

In addition, design changes are often requested by administrators after the design of a new system has been completed and programming is underway. Such changes meet with great resistance from systems designers and programmers, who often consider them to be frivolous. When the changes are dictated by outside forces (government requirements, faculty or union demands) much developmental work

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[14] An information system of similar basic design is in an advanced stage of implementation by The Yale College (New Haven, Conn.) Undergraduate Registrar using a PDP-11 Computer.

may have to be re-done. This may cause a contract re-negotiation and a general degradation in the working relationship between administrators and the computer technicians. With the Z-File approach, even the most drastic changes in report requirements can affect only one or a small number of report programs. The data input and file update programs are virtually immune to changes in report data requirements.

Information Flows

Detail flow charts, data descriptors, data file layout sheets and output report samples relating to the model information system for colleges and universities are presented in the Appendix. This model information system is designed in a series of modules which are related to the major administrative functions of the institution. The modular sub-systems take information <u>from</u> and feed information <u>to</u> the Z-File. Each module relates to the Z-File in the same manner that the petals of a daisy relate to the center (see illustration on the following page). The concept could be expanded into a three-dimensional model by considering the financial, budgetary and planning functions to be either above or below the central Z-File, since each of these functions affects all others.

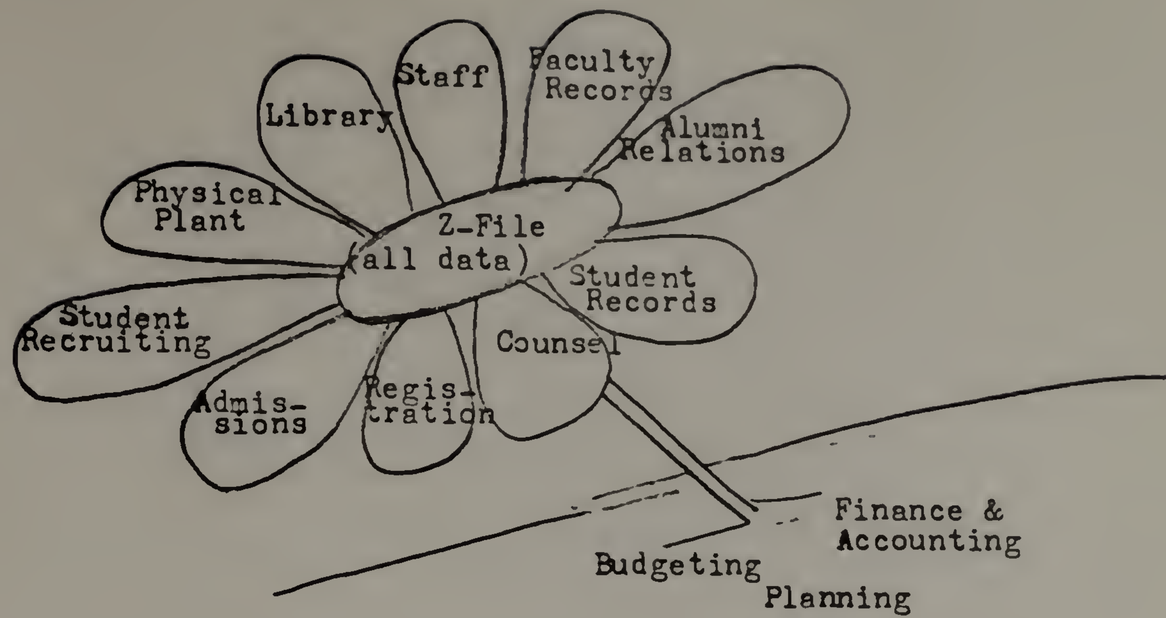

Figure 4-2 A pictorial representation of the model college information system that illustrates the relationship of important system modules with the central data file (Z-File).

The model system may be expanded by adding individual reports or entire system modules at any time without affecting the data flowing to other modules. This would allow a college to open a new department or improve information relating to alumni records without affecting other activities in the system. The concept illustrated by the model system also allows the system to be implemented one module at a time (in order to reduce the procedural dislocations which often accompany the introduction of computer methods in an organization).

A narrative description of each sub-system in the model information system is included as a part of the systems documentation in The Appendix.

How the System may Improve Decision-making in Higher Education

The literature quoted extensively in chapter three indicates that administrators in colleges and universities are in fact willing to spend much money on computer systems that are purported to assist them in making decision.[15] A study of the relationship between the two variables (improved information and decision-making) is outside the scope of this work. Some research has provided support for the hypothetical relationship.[16,17] More work needs to be done in the area.

Some movement in systems design toward a more careful consideration of human sensitivities and values was also noted in chapter three.[18] The question of whether an improved computer systems design method will actually be used by administrators and computer technicians to

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[15] See the book by The Carnegie Commission on Higher Education, The More Effective Use of Resources - An Imperative for Higher Education, McGraw-Hill, New York, 1972; also Danforth, William H., "Management and Accountability in Higher Education", AAUP Bulletin, Vol. 59, June 1973.

[16] This subject is discussed by Litterer, Joseph, in his book Organizations, Wiley, New York, 1969, p. 24.

[17] See also Helsabeck, Robert E., The Compound System, op. cit., p. 30.

[18] Sterling, Theodore D., "Guidelines for Humanizing Computerized Information Systems", Communications of the ACM, Nov. 1974.

design and implement college administrative data systems that will be more responsive to human needs is also outside the purview of this study. The assumption is made that college administrators do indeed wish to improve their services to campus constituencies, all other factors remaining the same and given adequate resources.[19] This study has discussed historical methods of computer systems design that have limited the flexibility of the administrative information systems in higher education. The assumption is therefore made that the improved flexibility and understandability that is the object of the model system design method will assist college administrators in obtaining information which will improve their decision-making.

Some specific examples of design features in the model college information system that will tend to assist in improving administrative decisions in higher education are indicated below. The features discussed are ideas that may appeal to certain administrators and not to others, depending on their perceived needs. The features have been difficult to implement in the past due to systems inflexibility. The model system documented in the Appendix is by no means limited to the features presented on these pages.

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[19] Litterer, op. cit. has approached this area, but this researcher could find no study that directly addressed the motivations of college administrators in utilizing computerized systems to improve campus services. Assumption is based on observation.

A major cost that has influenced the administrative decision to install a computerized management system is that of programming the computer. Another is the high cost of modifying programs as relatively minor forms changes cause data formats to change, thereby causing a series of related changes in manual data input procedures and computer routines. The model system will greatly reduce programming costs by eliminating the need for a programmer to laboriously redefine each piece of data used in each and every program in the system. It has been estimated that defining the data for a computer program that is written in the COBOL language can take as much as seventy percent of the total time needed to write the program.[20] In the model system an item of data need be defined only once. A special Data Useage Form is used for this purpose. The data definition is then keypunched into cards and fed into a computer file that contains definitions for all data items in the system. This data definition file (the Data-name Dictionary) provides data definition for all subsequent computer programs in the system. The logical sequence of data in each Z-File record is also controlled by another data definition file (identified as the "Data Map" in the Appendix). This means that

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[20] Davis, Gordon B., and Litecky, Charles R., Elementary COBOL Programming, McGraw-Hill, New York, 1971.

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE

CONTROL FIELDS A (7 ALPHA-NUM.) B (10 PACKED DECIMAL)			NAME OF ANALYST	DATE MO. DAY YR / /	PAGE OF
FILE CONVERSION SOURCE: CARD ☐ TAPE ☐	RECORD LENGTH	BLOCK :1	FILE IDENTIFICATION	HEADER LABEL FORMAT	

INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
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PRINT OR TYPE ALL INFORMATION

changes in data sequence on input forms will not require the re-writing of computer input edit programs. The changed data sequence is simply fed into the Data Map file, which then automatically modifies the relevant data edit routines.

Since the Z-File is designed to contain all registration data, including course descriptions, faculty assignments and space utilized, special courses may be scheduled without restriction by the computer system. Enrollment statistics, space utilization and faculty assignment data is available in detail or in any useful combination...at such time as they are needed.

Since the Z-File design permits a course or seminar to begin at any time, tuition billings can also be made at any time. Courses may end at any time and grades may be recorded at any time. Courses may be set-up that give variable amounts of credit as determined by the offering department and/or as determined by the instructor (based upon an evaluation of the effort and accomplishment of each student). Changes may be made to course length and credit-hours in mid-term. While the computer file imposes no limits on the institution, limits may be imposed on the system for control purposes (recognizing resource limitations and other organizational perogatives). If resources change the control limits may likewise be modified...at any time.[21]

Since an inventory of classroom seating capacity may also be kept on the Z-File, as well as the qualifications and teaching preferences of instructors, comparisons can be more readily made with student needs and preferences in order to develop schedules of course offerings which satisfy the needs of more people and more nearly optimize facility utilization. Building maintenance schedules could be more readily related to classroom useage and manpower availability in order to reduce maintenance costs and improve janitorial services. Since the Z-File contains all necessary information, a report could be made to maintenance supervisors each week indicating exactly which classrooms will be needed for what hours. This would increase the probability that essential services (lights, heat, etc.) are available in classrooms whenever needed. The same information could be given in summary form to higher administrative levels to assist managers in making decisions relating to building utilization. By more fully utilizing some facilities, costs may be saved by reducing the heat, lighting and maintenance services in some other buildings.

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[21] for a discussion of institutional system controls, see Voich, Dan, Jr., Mottice, Homer J., and Shrode, William A., <u>Information Systems for Operations and Management</u>, South-Western Publishing Co., Cincinnati, Ohio, 1975, pp. 407-432.

Since the student accounts receivable records will be on the same Z-File with the course results, transcripts of course grades and graduation lists may be more tightly controlled. Addresses on payment checks from students and alumni may be retained on the Z-File in order to maintain better communication with both constituencies.

Decisions related to faculty promotion and tenure may be assisted by carrying in the Z-File a faculty skill and publication inventory. Such information records would have to be designed carefully and with the assistance of faculty representatives in order to protect the rights of individuals concerned. However, such information as level of competence in various areas of teaching and research within the purview of a faculty member might be used. Basic data on institutions attended, conferences attended, papers given and major areas of study could be used to provide a more complete picture of faculty performance to deans and department heads. A publication record could also be maintained on the Z-File by author (primary or contributing), title, research area and publication date. This would facilitate cross-referencing in order to verify claims for publication credit on the part of a faculty member.

Finally, it should be evident that the nearly unlimited variety of data on the Z-File lends itself to the development of operating statistics that have a wider range than those provided by more limited files. This should permit administrators to analyze the performance of many sectors of campus services as compared with not only operating budgets (which would be on the Z-File) but with many other relevant factors in their operations.

In relating a system that is as flexible as is the Z-File concept to an organization that is as changing (and challenging to define) as is the modern college or university one is tempted to continue indefinitely in discussing different aspects of potential applications. It is the belief of this researcher that an adequate cross-section of system features and potential applications has been presented to allow the reader to sense the broad scope of the potential use of the design concept. Those who are interested in the technical details of the system design and related documentation are referred to the Appendix.

As a final bow to those involved in Institutional Research, attention is called to one of the most powerful aspects of the design. The ability is provided to code cost data on the Z-File in several different ways to relate to different departments, programs, plans and budgets. Cost codes may also be provided for several organizational levels (including the HEGIS[22] system). Also, new records

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[22]Caffrey and Mosmann, _op_. _cit_.

containing different cost codes and structures may be easily introduced as requirements change or are imposed. Old data on the file, since it is in a dis-aggregated form (maximum detail) can be re-allocated to new project, organizational or program codes based on parameters that are developed after the original data was stored on the Z-File. The clear audit trail of all Z-File data with regard to its origin will further substantiate the cost reports.

Summary

The model information system discussed in this chapter and developed in detail in the Appendix is a response to an increasingly evident need as expressed in the current literature and through observation. While the system does not achieve the simplicity of a manual accounting system, it is designed to provide much more information to a larger constituency and still retain adequate controls. It has been represented in prior chapters that many computerized systems for higher education, while very powerful and flexible, have become too complex to be effectively controlled. This chapter has hopefully explained the basic design of the model system in a way that clarifies the three main objectives: power, flexibility <u>and</u> <u>controllability</u>.

CHAPTER V

POSSIBLE METHODS OF EVALUATING THE SYSTEM

Evaluation can relate to the impact of an information system on its external environment or to the qualities of a system's internal technology. While the evaluation process is not yet refined to a level where we may state with certainty that all aspects of a proposed educational information system may be fully evaluated, certain valuable tools have been developed which should be considered. The function of evaluation in the design of an improved operating system for higher education is necessary if we are to make any accurate judgement concerning the value of the end results of the changes we propose, or of the steps leading to those results. Although it may be possible to obtain some idea of the overall accomplishments of a system through the more or less traditional use of expert judgement, the complexity of the information system and of the higher education organizational context in which it is imbedded is such that a more structured approach to evaluation is indicated.

The evaluation problem in this situation is that a computerized information system for the management of a college or university is basically different from the classroom or curricular evaluation systems that are familiar to many educational specialists. First, the administrative system itself consists of a complex network of more or less linear information flows which may or may not be decision-oriented. A major portion of the information in the system relates to mere record-keeping or data storage... even though such data may in the future influence some decision. Second, the decisions that are made by the post-secondary organization are not as structured as those which may be made in a high school classroom or by a director of a curricular program. Decisions in the organization that we are considering are affected by both bureaucratic and political pressures that may or may not be present in the primary/secondary classroom. In higher education decisions may be made by different persons under different circumstances (perceived importance, information available, political context, etc.).[1] Therefore, the system to provide information relevant to these less structured decisions must be flexible enough to accomodate the idiosyncrasies of the organization. Any method of evaluation that is devised should not impose such rigidity upon the system that its effectiveness is degraded, or that its cost becomes prohibitive.

This chapter will:

1. Review some of the relevant educational evaluation methods.

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[1] Lindquist, John D., and Blackburn, Robert T., "Middlegrove, The Locus of Campus Power at a State University", <u>AAUP Bulletin</u>, December 1974, p. 367.

2. Apply certain of these methods to the problem of evaluating the proposed information system if it were fully implemented.

3. Describe what steps may be considered as appropriate to make some relevant evaluative statements about the systems model which is the focus of the dissertation.

It is not the purpose of this section to propose or develop a firm method for evaluating the systems model. Rather, we seek to identify certain parts of educational evaluation methods which are described in the literature which may be combined with technical methods of computer system evaluation in order to present a better overall picture of the potential value or merit of the information system in question.

Evaluation in Education

Evaluation in education has been practiced for many years. However, in recent years much innovation has been applied to evaluation methodology. The traditional techniques of using expert professional judgement and/or measurement (testing) in order to evaluate an educational process are still very much in use. The value of these techniques has been proven through years of trial. But even these techniques are undergoing some change. The impetus for this change and innovation has in recent years been provided by the U. S. Office of Education which is seeking continued improvement in the educational system, by taxpayers and school boards who seek justification for the high costs associated with education, and by those educators who seek to improve the quality of their work and the results of their efforts. This pressure for improved justification of expense and improved end results of education has created a system of specialized methodologies that are designed to provide the necessary information to all parties concerned. Thus, the basic tools of expert judgement and testing have been expanded into the broad and dynamic field of educational evaluation.

Before discussing some of the contributions of leading writers in the field, it is important to observe that to date most of the new technology has been related to the evaluation of processes and end results in primary/secondary education. This is not to imply that no work is being done in the area of higher education. Some colleges and universities are undertaking formal programs of instructional improvement. Administrative management in higher education is acquiring a powerful set of cost-control tools in the form of computerized information systems and models that assist in decision-making in many functional areas of operations. The work of the National Center for Higher Educational Management Systems (NCHEMS) at WICHE is one of the leaders in both these fields. However, many of the complex methods of evaluation that are being used in primary/secondary education have not yet penetrated to the level of the university. Perhaps the needs of higher education are simply different. While much effort is now being exerted in the area of curriculum development and teaching within a given classroom in primary/secondary schools, such detailed analyses do not appear to have made much impact on teachers or course planners in higher education. Perhaps the evaluation models that have been developed for primary/secondary schools will someday be used in higher education. But as of today, the thrust of development that is the interest of the authors discussed below is focused in areas other than higher education. Perhaps the field is just too new. According to Worthen and Sanders,

> "Evaluation is one of the most widely discussed but little used processes in today's educational systems. This statement may seem strange in the present social context where attempts to make educational systems accountable to their publics are proliferating at a rapid pace. The past decade has seen legislative bodies at both national and state levels authorizing funds to be used expressly for evaluating educational programs to determine their effectiveness. ... Yet, despite these trends toward accountability, only a tiny fraction of the educational programs operating at any level have been evaluated in any but the most cursory fashion, in indeed at all."[2]

Among specialists in the field, there is considerable disagreement concerning an acceptable definition of the term "evaluation" as applied to education. The dictionary definition (to determine the worth of; to appraise) has been expand-

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[2]Worthen, Blaine R., and Sanders, James R., Educational Evaluation: Theory and Practice, Charles A. Jones Publishing Co., Worthington, Ohio, 1973, p. 1.

ed to include such concepts as measurement, expert judgement, data identification and collection, data analysis, and "decision alternatives".[3] While it is outside the scope of this paper to go into the details of the various positions, a summary of the three major approaches is relevant to our purpose.

Testing and expert judgement. Since the development of the measurement movement (more than three decades ago) many testing and measurement specialists have used their work as a definition of evaluation. Today such work is continued by such specialists as Thorndike and Hagen[4]. The Educational Testing Service (Princeton, N. J.) is only one of the several organization dedicated to continuing research in this area.

At about the same time, certain formal methods of evaluation were developed that were based upon the exercise of expert professional judgement. Such a method uses the observations of one or more qualified "experts" in the field to make rather subjective judgements about the overall merit or worth of an educational process. Forms and check-sheets are sometimes used in order to provide structure for the examination, and objective data is collected where it is

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[3]Summarized from the discussion in Worthen and Sanders, Ibid., p. 20.

[4]Thorndike, R. L. and Hagen, E., Measurement and Evaluation in Psychology and Education, Wiley & Co., New York, 1969.

available. But in the end, this method depends on the informed judgement of the experienced evaluator. An example of this activity is found in the many accreditation boards which are designed to provide some type of quality control evaluation for educational organizations.

<u>Pay-off models</u>. Another tendency in evaluation (there are many overlapping ideas) is to consider the success of an educational process in achieving its goals. This results (or "pay-off") approach developed during the 1930's with the work of Tyler[5]. The basic process compared performance data on an educational program with specific pre-determined objectives or criteria. Testing and professional judgement were considered to be a part of this process. Cronbach[6] developed these ideas further. He felt that the <u>Taxonomy of Educational Objectives</u>[7] could be used to assist in the development of definitive course objectives and that tests could be devised which would provide some measure of achievement.

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[5]Tyler, Ralph, W., "General Statement on Evaluation", <u>Journal of Educational Research</u>, 1942, 35, pp. 492-501.

[6]Cronbach, Lee J., "Course Improvement Through Evaluation", Teachers College Record, 1963, 64, p. 673.

[7]Krathwohl, David R., Bloom, B. S., and Masia, B. B., <u>Taxonomy of Educational Objectives: Handbook II: Affective Domain</u>, David McKay & Co., New York, 1964.

Scriven[8] moved toward more detailed "intrinsic" evaluation of basic course content. He developed the ideas relating to the use of "micro-objectives" within a course and of an expanded bank of test items that would relate to these objectives. Today computers are used to store large banks of test items, and this "Criterion-Referenced Testing" is implemented in over 100 schools.[9]

Decision-Management. The decision management viewpoint is perhaps the most popular view of educational evaluation. Writers in this area include Stufflebeam[10], Guba[11], and Alkin[12]. Their approach places primary emphasis on program description (data collection and storage for use by decision makers). Stufflebeam uses information relating to program Context, Input, Process and Product (CIPP). For a person who must make decisions about course structure or content, he believes that evaluation is the process of ascertaining

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[8] Scriven, Michael, "The Methodology of Evaluation", Perspectives of Curriculum Development, Rand McNally, Chicago, 1967.

[9] ________, Performance Objectives and Criterion-Referenced Test Items, a booklet printed by National Evaluation Systems Inc., Amherst, Mass., 1974.

[10] Stufflebeam, Daniel L., et al., Educational Evaluation and Decision Making, Wiley, New York, 1971.

[11] Guba, E. G., "Evaluation and the Process of Change", in Notes and Working Papers Concerning the Administration of Programs, U. S. Senate, Title III ESEA, Washington, D. C., 2 (1), 1967, pp. 2-7.

[12] Alkin, M. C., "Evaluation Theory Development", Evaluation Comment, Vol. 2, 1969.

the relative values of competing alternative decisions. Evaluation, in his view, should be a continuing and cyclical process that is based upon a systematic program.

Many researchers look to the computer to provide some breakthrough in evaluation methods. Computer methods of evaluation have been generally limited to test scoring, computer assisted instruction, student flow prediction models, cost control models and operating systems, and other means of providing basic data for presentation to decision-makers. However, as the technology becomes more sophisticated (and complex) one may predict that the computer will move deeper into the problems...eventually making some of the decisions now reserved for humans. This trend may see total monitoring of educational systems via computer control. An example of this trend is the Comprehensive Achievement Monitor[13] program that uses computer controlled test batteries to follow a pupil's progress through an entire complex learning program (such as several years of mathematics). This trend may be seen by some as a movement toward educational centralization, in that the individual teacher will have less to say about what a pupil learns. This, in turn, may require a reconsideration of the role filled by the teacher...and of the training needed for that role.

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[13]This is another development product of National Evaluation Systems, Inc., Amherst, Mass. The concepts were first developed by Dr. Dwight Allen at Stanford University.

Evaluation of Computerized Higher Educational Information Systems

There is a basic difference between management information systems and higher educational information systems. It is the fact that management, if it exists at all in higher education, is quite well hidden.[14] The basic functions of management (planning, organizing, controlling, etc.) are accomplished in higher education within a political rather than a more traditional framework. As discussed in Chapter II, the highly organized decision structure that is found in business and government is usually lacking in a college or university. While there are certain sections or departments which may exhibit management-like tendencies, this may be simply that the political nature of that section is also hidden.

If an information system is to be re-designed for an organization (there is always some kind of existing information system), it is usually required that the designers of the new system find out <u>how</u> decisions are made and <u>who</u> needs <u>what</u> information related to these decisions. Management must be made visible. The process must be understood, so it flow-charted, analyzed and possibly computerized. The fact

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[14] The source of this discussion is a paper by George W. Baughman, "Evaluating the Performance and Effectiveness of University Management Info-Systems", from the Seminar on the Advanced State of the Art, Western Interstate Commission on Higher Education, Boulder, Colo., 1969.

that there is as yet no fully implemented management information system on computer at a college or university indicates the difficulty of the problem. In industry, where organizational structure is much simpler, there are still very few totally computerized management information systems. Considering the highly complex nature of university organizations, it will be a long time before all campus administrative systems are computerized.

Since the university is a pluralistic polity which traditionally responds to vested interests from both within and outside of the organization, most decisions become compromises which may or may not relate to economic rationalism. Further, such political decisions are seldom identified with a single person or point of view. They appear as group actions. Therefore, the "management" of a university requires a delicate balance between economic and political rationality. An information system may be designed to assist some of the functions, but it cannot replace the political nature of the institution with industrial-type decision patterns. It may be possible that a specialized computer system could be designed that would be flexible enough to serve the diverse political/economic/human needs of the academic organization. Evaluation criteria that is established to judge the merit of such a system must consider all possible aspects of the organization the system is expected to serve.

Large-scale System Evaluation

An attempt to implement a large-scale computerized management information system within a college or university should include plenty of time, manpower, money and other resources. Even with these factors in abundance, there is no assurance of success. And if a system is indeed designed and implemented one cannot be sure the political nature of the organization will accept it or put it to its highest use. The risks are many, the complexity of the project is overwhelming, and the people who are available to do the job may not have adequate training or ability for the task. University computer centers are not known for paying the highest wages in the industry.

Evaluation of such a project is difficult because its scope is so huge. If organizational criteria are developed, the organizational analysis to support the criteria may consume the majority of the project budget. Most often, a set of generalized criteria is used in order to obtain the approval of the project by top administration. This is not ideal, since very general criteria do not permit much hard data to be developed for a subsequent evaluation.[15]

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[15] A current discussion of this is provided by Robert Roach in the article "RAMIS at Citibank", Datamation, December, 1976, p. 83.

Evaluation criteria for a computerized management information system in higher education might include both organizational and technical factors. Such criteria would include such questions as:

1. Does it work dependably?

   a. Does it get, keep and recall the data as needed?

   b. Does it provide for timely management and operational reports?

   c. Does it detect and facilitate correction of errors?

   d. Does it provide adequate audit trails for the verification of data in the file?

2. Does the system provide for change?

   a. Is it readily moveable to new equipment?

   b. Is the system easy to modify as needs change?

   c. Is growth potential built into the system?

   d. Is the system independent of its creator?

   e. Does it provide for changing data and report requirements?

3. Is the system cost-effective?

   a. Low initial cost?

   b. Low maintenance and operating costs?

4. Is the system easy for its operators to use?

   a. Is the system too complex to be understood and controlled by its users?

   b. Is the system adequately documented?

After these basic questions have been considered, technical features of the software and operating procedures may be compared with those of competing systems in order to come to some conclusion about the relative merits of the system.[16]

Evaluation of the Proposed Model System

A smaller system, such as the model Z-File system, can be expected to have goals which are easier to define. Its more limited scope will therefore enable more adequate evaluation procedures to be established. The implementation of a management information system for a smaller college or university would possibly be evaluated in the following manner:

1. Decision-level analysis of operational functions would be performed along with the basic analysis of current data files (manual and mechanized) and present reports used. Even though the organization of the college may be highly political, the functions at this level do not change so much that some comprehension of daily operating decisions cannot be obtained.

   When the new system is installed, even on a test basis, an evaluation can then be made that relates data needs to that which is provided, under such criteria as timeliness of reports and accuracy of data.

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[16] Many of these steps are discussed in Schussel, George, "Systems Management: Scoring DP Performance", Infosystems, Sept., 1974, p. 60.

The Fortune/Hutchinson Evaluation Methodology[17] might be used in order to develop criterion-referenced data for system evaluation by decision-makers. This methodology involves the use of a log for each decision-maker that enables him or her to record each decision made in terms of the data requirements of that decision. Information on this log is then weighted and prioritized by the evaluator in relation to the goals of the system in order to determine the level of data useage in the organization.

2. The users, or potential users, of the information provided by the system can be polled on their opinion whether their needs are (or will be) met by the system. This method might be satisfactory as long as adequate information was given to the users about the new system, and also if the evaluation compared the results of the system with valid criteria in a way that would allow judgement to be made concerning the merit of the system.

3. Technical comparisons can be made with the results obtained by similar data systems that have been or are being installed in other academic organizations of comparable size and nature. Administrative and technical journals in the field frequently contain articles about user experience with new data systems or comparisons between systems.[18] User organizations are also valuable sources of technical information.

4. The system can be evaluated through the mature judgement of experts in the field of higher educational information systems.

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[17] Benedict, Larry G., "The Fortune/Hutchinson Evaluation Methodology: A Decision Oriented Approach", paper presented at AERA Convention, New Orleans, 1973 (mimeo).

[18] One of many recent articles that compare various commercially marketed data systems is Gepner, Herbert L., "User Ratings of Software Packages", Datamation, Dec. 1976, p. 108.

> Such persons would relate the overall design and potential of the system in meeting the information needs of the users; thereby making judgement concerning the merit or value of the system.

Traditional computerized information systems in industrial and governmental organizations have rarely been subjected to any formal evaluation methodology. The same may be said of college and university systems. However, an evaluation phase is now included in many proposals for new or improved information systems. Usually this phase is the final one in a new system development project, and it is often merely a semi-formal review of the problems encountered during the project.

It is the opinion of this researcher that a combination of the four steps that have been outlined on this and the previous pages would be a very adequate evaluation methodology for an implemented higher educational information system. The evaluation of the system when it is in the model (or pre-implementation) stage can best be done using the fourth method outlined above...that of the mature judgement of experts in the field.

CHAPTER VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER STUDY

Chapters one and two of this thesis have discussed the increasing need in higher education for administrative information systems that are both adequately flexible and dependable. These requirements stem from the complex and changing nature of college and university organizations and from the nature of the services they perform. We have also seen that the increasing size and sophistication of computerized data systems has tended to make them comprehendible to a very limited number of highly trained technicians. This over-complexity of computerized systems has tended to reduce their cost-effectiveness and flexibility in higher educational applications. It has also tended to limit the dependability of the information provided to administrators.

Chapter three presented material from the literature on the subject that indicated the various approaches that have been (and are being) taken by others in attempting to meet the information needs of college and university administrators. Although there are some exceptions reported, it was noted that most of the systems now being presented to administrators as solutions to their problems are highly sophisticated approaches to the problem of flexibility. The equally important problems of system over-complexity and data dependability have not been fully addressed.

An information system design was outlined in chapter four to provide a computerized data management system for post-secondary educational administrators. The basic design criteria for the system presented is flexibility and data dependability. Many design ideas (some original and some developed previously) were brought together in this design approach, the results of which provide a model information system whose coherent design philosophy goes farther than any other now available in the direction of flexibility and controllability. The key to this controllability (and the related data-dependability) is the design simplicity of the data files used in the system. This synthesis of ideas has resulted in the design model of the Z-File system which is presented in detail in the Appendix. Several possible approaches to the evaluation of the design model were presented in chapter five, with the suggestion that the expert judgement of qualified persons would be the most effective.

CONCLUSIONS

Full implementation of the design model is outside of the scope of this dissertation, due to the constraints of both time and money. However, programming work is being done on the first two modules of the Z-File system. It is estimated that the first phase of the actual system development will be completed by the fourth quarter of 1977. This first phase would encompass the data definition ("shadow") sub-system, the data input edit and Z-File update programs, and the important control file (data-dictionary) linkages that allow the system to function. After appropriate testing, the second developmental phase will consist of the pre-programming of several more-or-less standard administrative reports and the related routines to extract necessary data from the Z-File. The Z-File system would then be ready for a test implementation on a college campus (perhaps at first through some type of simulation). It is envisioned that actual campus implementation would be based on report programs that were customized for the particular academic organization involved. The COBOL Synthesizer Program (for the near-automatic generation of report programs) would be developed during a final phase in systems implementation. This final phase would also include extensive system testing and formal evaluation, as well as final documentation.

Implementation of the Z-File system on campus. There is a strong probability that actual implementation of an information system that is based on the Z-File design philosophy would be easier and quicker than most other Data Base Management Systems. While the same system may be used to accomodate all administrative data sub-systems on campus, a step-by-step approach can be taken in order to reduce the complexity of the entire project. A few key reports can be developed quickly for one administrative function (for instance, admissions) and then another (say, accounting/payroll). Only the data necessary for the first group of reports need be placed on the Z-File, since unlimited additional types of data can be added at any subsequent time. Implementation, therefore, may take place in phases in any campus organization, with no group being rushed or delayed by another. This should greatly reduce the tensions and organizational dislocations that often accompany the installation of a new data system.

Within a particular function, such as the alumni office, phased implementation would probably take place as follows:

1. Since all data is placed on the Z-File under the control of the Shadow System, no programs must be written to establish the files. Existing data (manual or computerized) need only be described to the Z-File using the Data Useage Forms (see the Appendix for more details). Data descriptor information from these forms is input to the Shadow System control files. These control files (data-name dictionary and data map) in turn set-up the actual transaction data input edit and Z-File update programs to accept and store the required data.

2. Once the first batch of transaction data is established on the Z-File, programs can be developed to summarize that data on administrative reports.

> The report-printing programs could probably be written at the rate of any normal report written in the COBOL language (between 3 and 10 work-days, depending on complexity). A short routine must also be written for each report to extract the required data records from the Z-File and sort them as necessary. When the COBOL Program Synthesizer subsystem is operational, the preparation of a new report program should take only a few hours and will usually not require the services of a trained programmer.

Since the above steps may be taken for each report as slowly or rapidly as each organizational section desires, the risk that a new system will cause severe organizational dislocations (confusion, lost records, increased tensions and erroneous data) will be greatly reduced. Since errors in the system may be more easily corrected before they are compounded, the overall validity of data in the Z-File system should be improved....thereby further contributing to the dependability of the system.

Reduced complexity. The Z-File system design philosophy relies on the synergistic inter-relation of a series of modular computer programs to develop the necessary internal controls. However, each module (including the Shadow System) has been in itself designed using the rather unusual criteria of simplicity and understandability. This will facilitate continued improvements within programs as opportunities become evident. The technical documentation presented in the Appendix attempts to illustrate the straightforward structure of each computer program. It is felt that this fundamental simplicity of design greatly enhances the overall flexibility and dependability of the system...and the administrative information it is designed to support.

Recommendations for Further Study

It may be suggested that other system designers independently develop and test models that are based on a similar design philosophy in order to provide additional data concerning the relevance of the approach to other aspects of educational information systems (such as divisions of large universities and perhaps secondary education).

The model system is designed to enable implementation on a college campus with or without the use of the COBOL Report Program Synthesizer (see the Appendix). While the COBOL Synthesizer is not presented as an intrinsic part of the model college administrative information system, it seems to represent an intriguing extension of the basic concepts of the model system. It is therefore suggested that further research and developmental work be done in the area of need that is represented by the COBOL Synthesizer. Its use would perhaps bring the availability of decision-related information more quickly and easily into the hands of the college administrator.

The COBOL Synthesizer program could also be used to generate to COBOL Data Division and some Procedure Division coding for computer programs which are outside the design limitations imposed by the Report Synthesizer Form. In this way, the time needed to program such applications could be reduced.

The behavioral aspects of information systems that were identified in Chapter IV appear to provide an opportunity for further research. While there is substantial literature on the subject of administrative decision-making, so many variables bear on the subject that a direct causative relationship between the information provided on reports and decision-making has not yet been firmly established (although the relationship is generally accepted).[1] However, the nature of the organization in higher education narrows the scope of administrative decision-making. As discussed in Chapters II and IV, much of the administrative function is related to the custodial responsibilities of college administrators. It would therefore appear that the limited decisions that are delegated to certain administrative positions could be more closely linked to supportive information. If such a link were more firmly established, the hypothesis that improved information systems result in improved administrative decisions would be more strongly supported. Further research in this area would seem warranted.

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[1]Litterer, Joseph, <u>Organizations</u>, Wiley, New York, 1969, pages 24 and 299.

The subject of using improved information systems to create a more humanistic and supportive environment on the college campus has not yet been extensively discussed in the literature. Sources that are available are more related to computer technology than to behavioral or educational research.[2,3] Although the relationships between "information" and "a humanistic educational environment" are probably very complex, this would possibly be a rewarding area for further research.

Finally, this writer hopes that others will be able to profitably utilize some or all of the design concepts embodied in the model Z-File system to facilitate their own efforts. The results of the future implementation of this system will be made public.

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[2]Further reference is made to authors cited in Chapter III: Barone and Benzel, "Personal Approach to Admissions", op. cit., p. 172; also, Sterling, "Humanizing Computerized Systems", op. cit., p. 609.

[3]Sterling, Theodore D., and Laudon, Kenneth, "Humanizing Information Systems", Datamation, Vol. 22, no. 12, Dec. 1976.

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APPENDIX

APPENDIX

DOCUMENTATION OF THE MODEL SYSTEM

The following sections present the conceptual and the technical documentation of the proposed model system for higher education. The sections cover all aspects of the system, including:

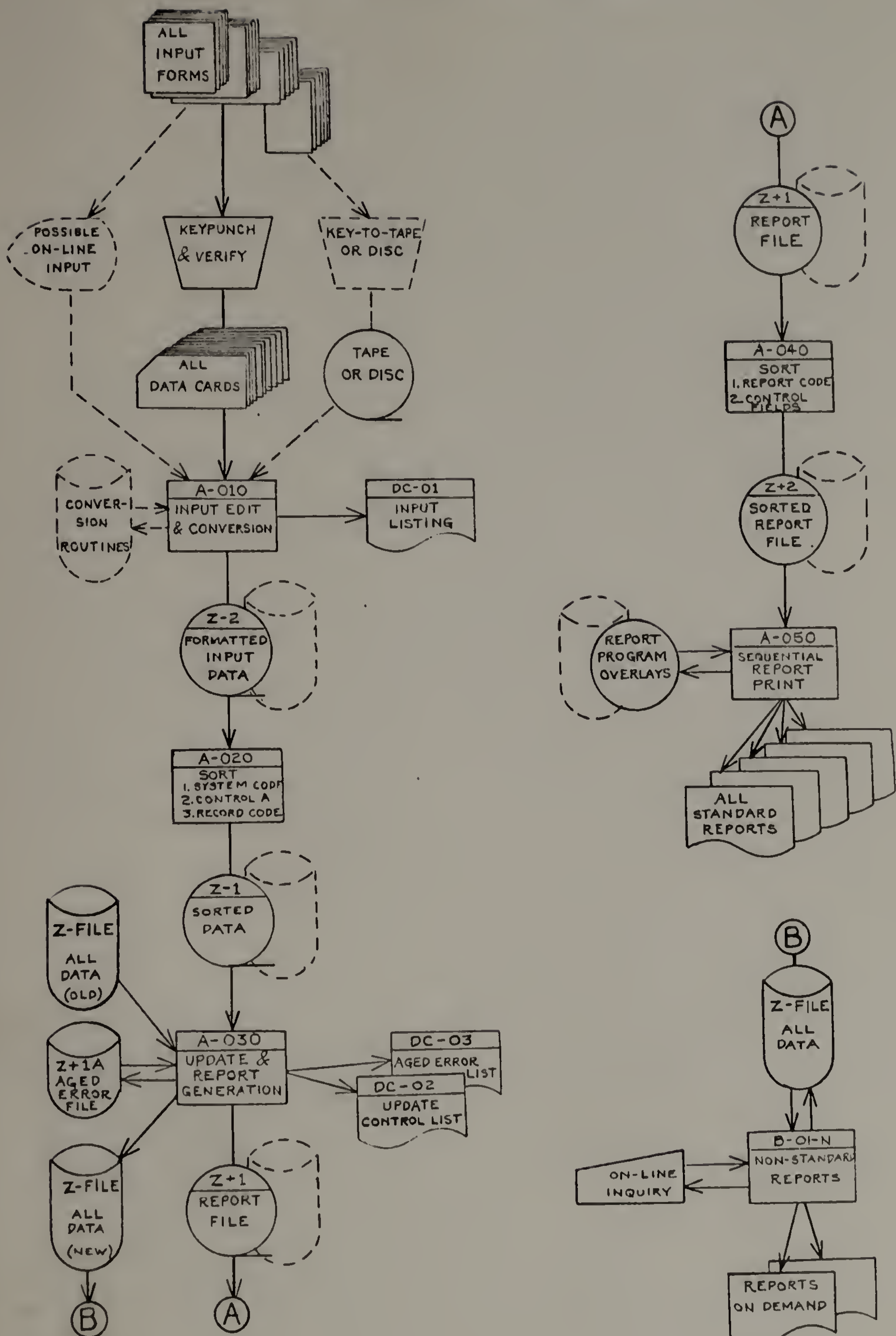
- Data organization of the Z-file
- Data flow charts on each major application
- Form samples
- Data descriptor forms
- Report samples
- Sample file designs
- Technical computer program documentation

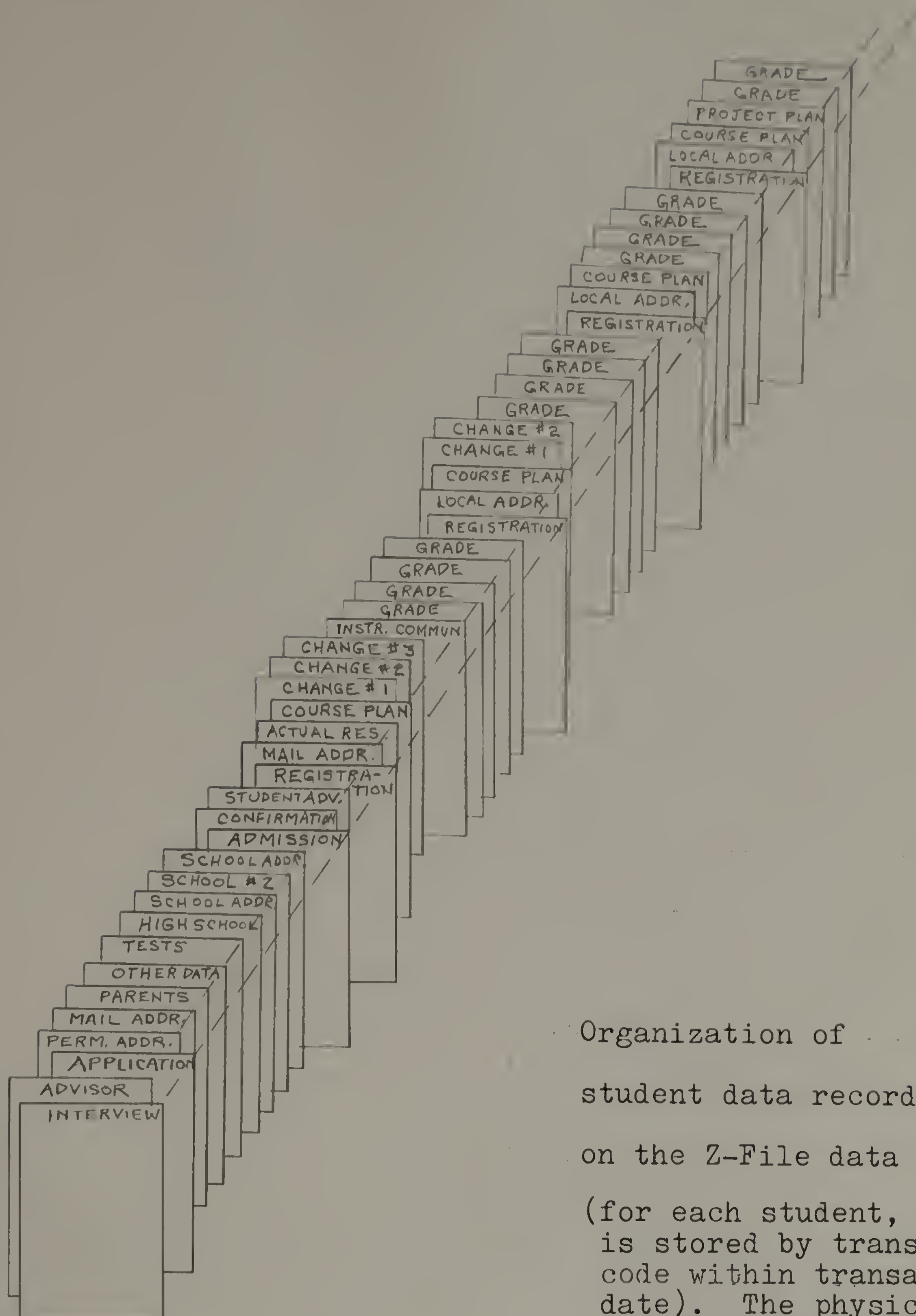
The data flow charts on each major application appear on the pages immediately following this introduction. The illustrations show the flow of data into and through the Z-file system that relate to many of the important applications of the system. The work of a college or university has been divided into major systems and sub-systems for illustrative purposes. The data from each of these systems and sub-systems is shown flowing through the Z-file data bank and on to relevant control reports. While not all the systems and reports have been illustrated in this model system, an attempt has been made to provide full technical detail on a segment that is of adequate size to show the power and flexibility of the Z-file system concept as applied to higher education.

Many of the symbols used in this documentation have been standardized in order to facilitate understanding of the model. Often a punched-card symbol is used to illustrate data input to the Z-File system. It is to be understood that this symbol represents such other input methodologies as paper tape, key-to-tape, key-to-disc and/or any of the many terminal-oriented input or inquiry methods. Similarly, the report symbol must be assumed to mean any of the various media which may be used to provide information to administrators, from printed reports (standard or one-time) to CRT (television) display of data for inquiry or update. The Z-File model system can accomodate any type of data input or output methodology that is now in use or planned.

The sample forms and reports are shown to further illustrate the features of the model system. It is recognized that a particular college or university would require the use of different forms and may need different data formats and reports than those shown.

Z-FILE SYSTEM OVERVIEW





Organization of

student data records

on the Z-File data bank

(for each student, data is stored by transaction code within transaction date). The physical data location on the Z-File is controlled by the data-dictionary.

CONCEPTUAL DATA FLOW CHARTS

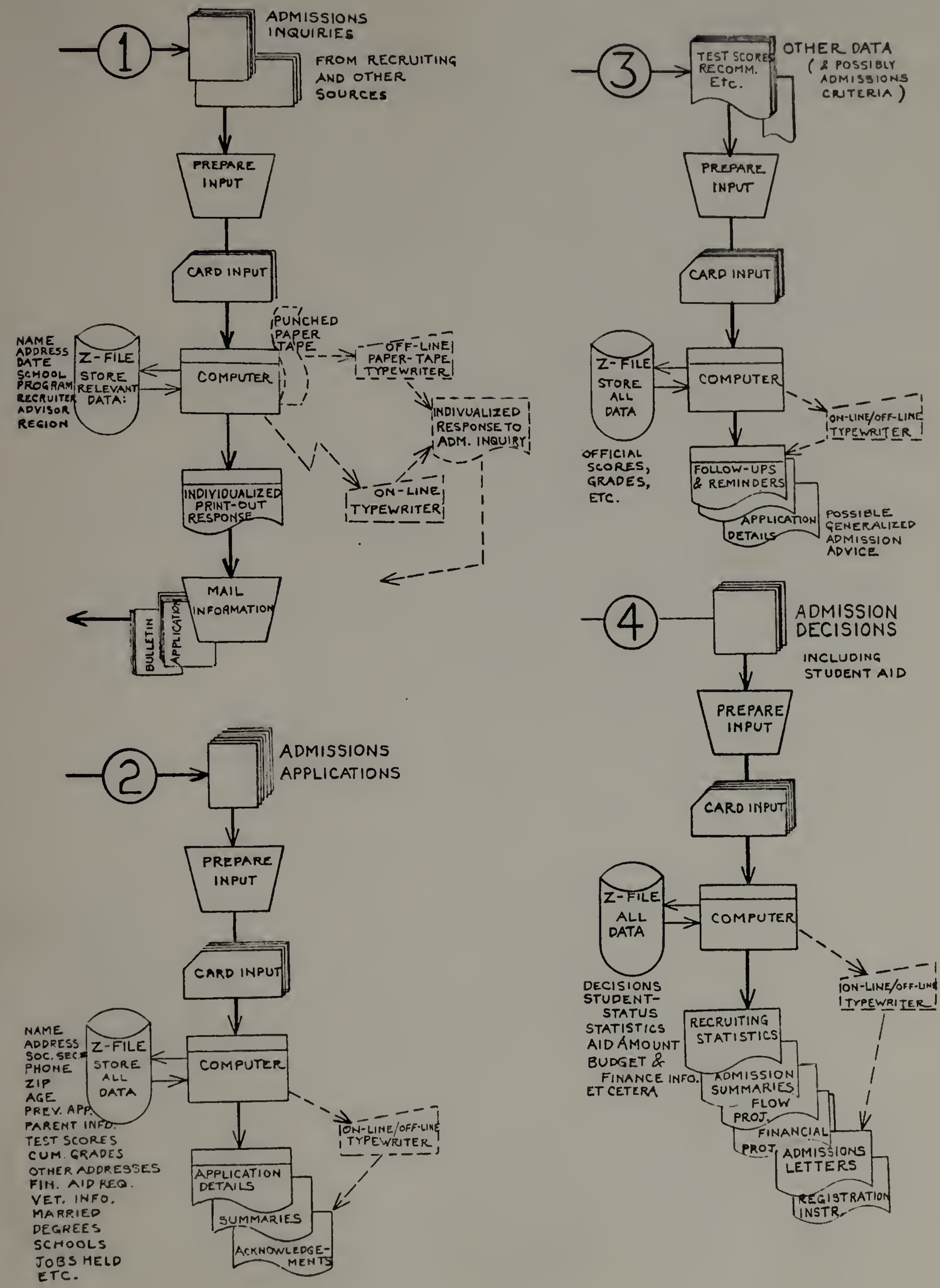
Please note:

On the following pages are shown high-level flow charts of the conceptual Z-File system as seen by the user.

The symbol for "card input" used to show data flowing into the computer may be assumed to represent any possible method of data input, including on-line entry.

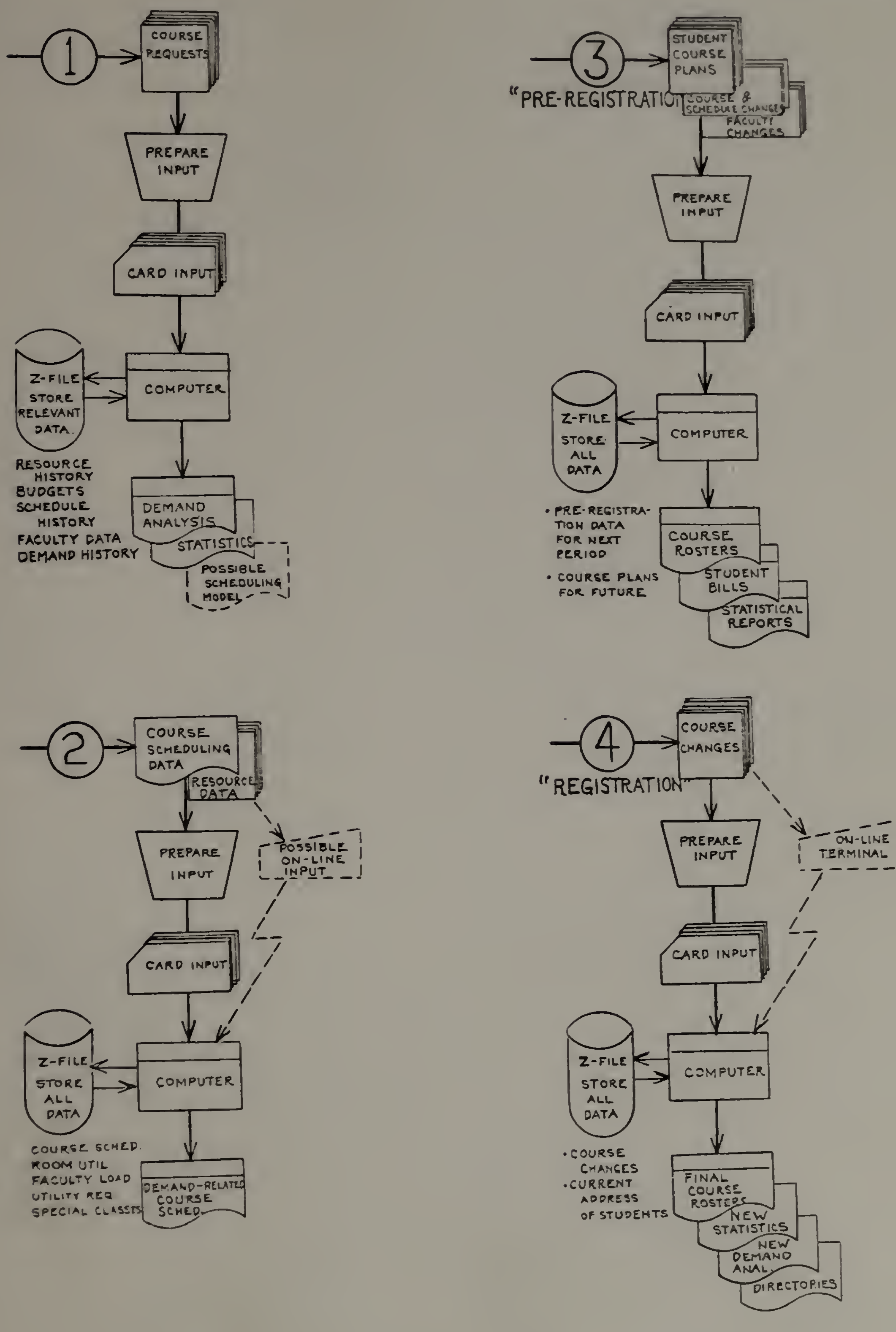
CONCEPTUAL DATA FLOW

System: STUDENT — Subsystem: ADMISSIONS



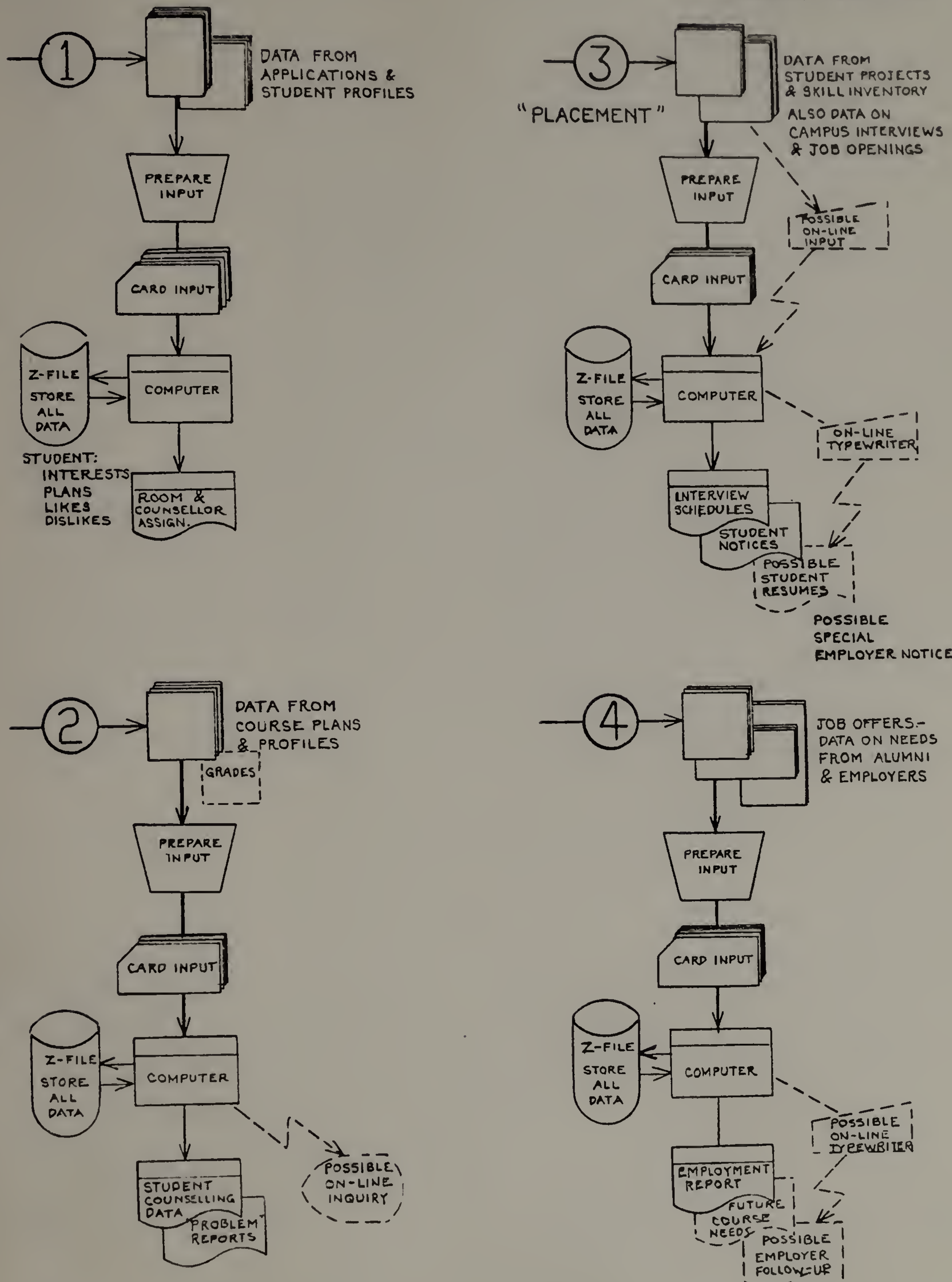
CONCEPTUAL DATA FLOW

System: STUDENT – Subsystem: REGISTRATION



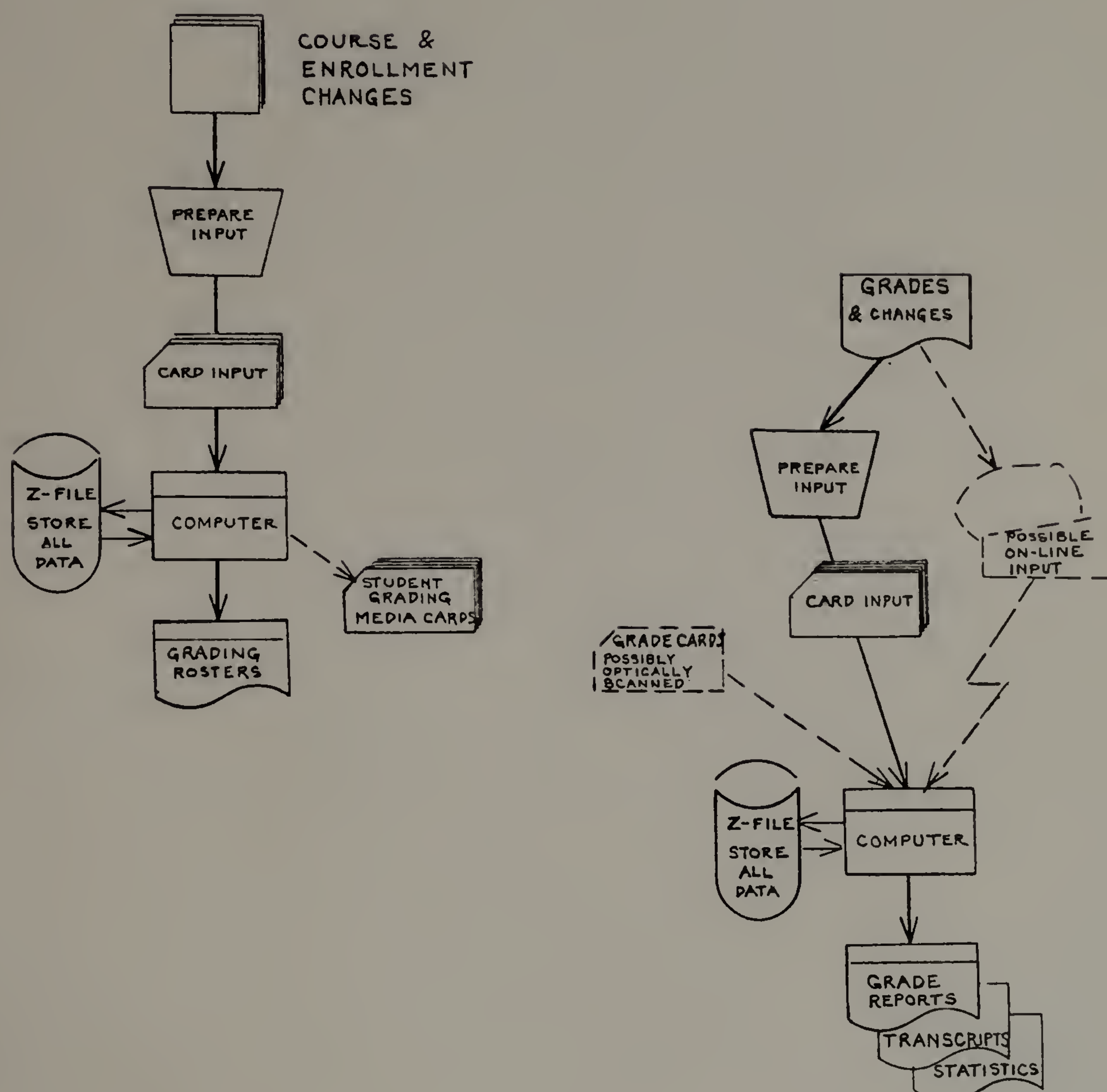
CONCEPTUAL DATA FLOW

System: STUDENT - Subsystem: COUNSELLING & CAREER DEVELOP.



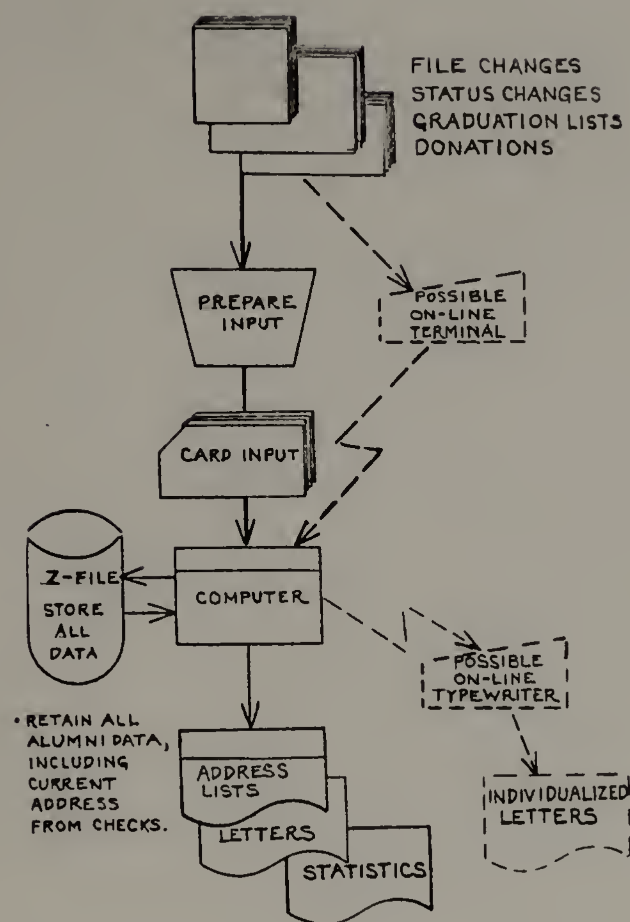
CONCEPTUAL DATA FLOW

System: Subsystem:
STUDENT - GRADES



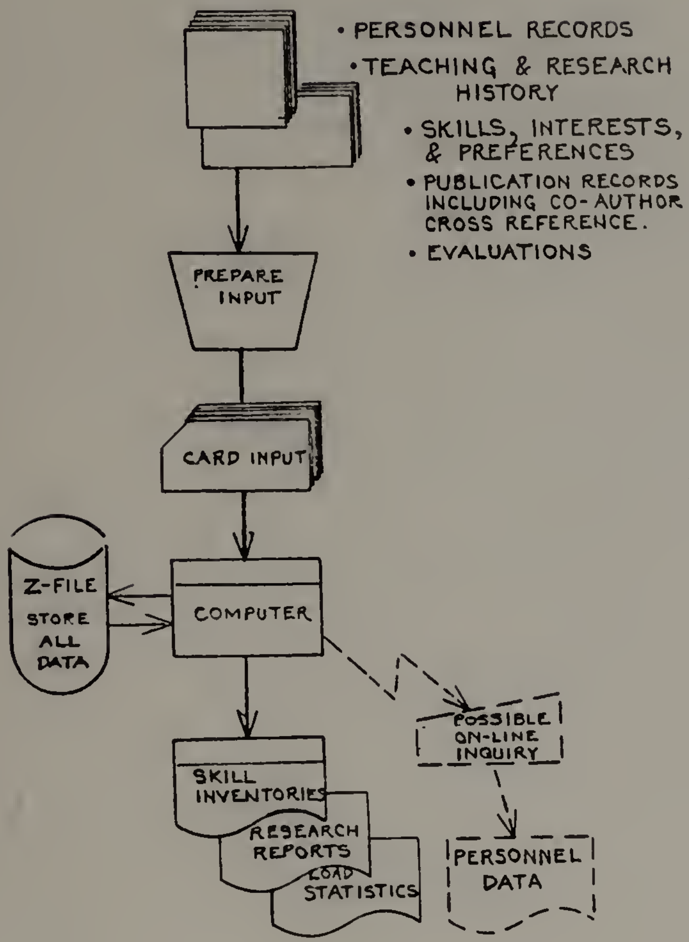
CONCEPTUAL DATA FLOW

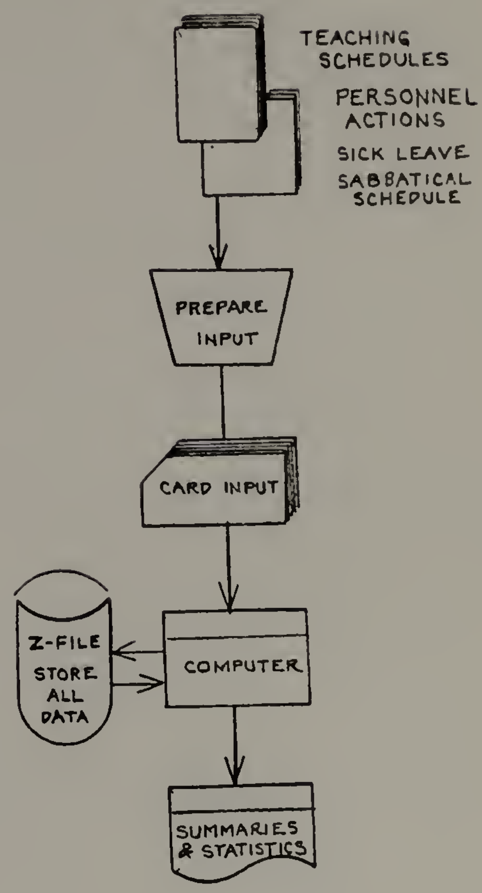
System:
ALUMNI & FRIENDS



CONCEPTUAL DATA FLOW

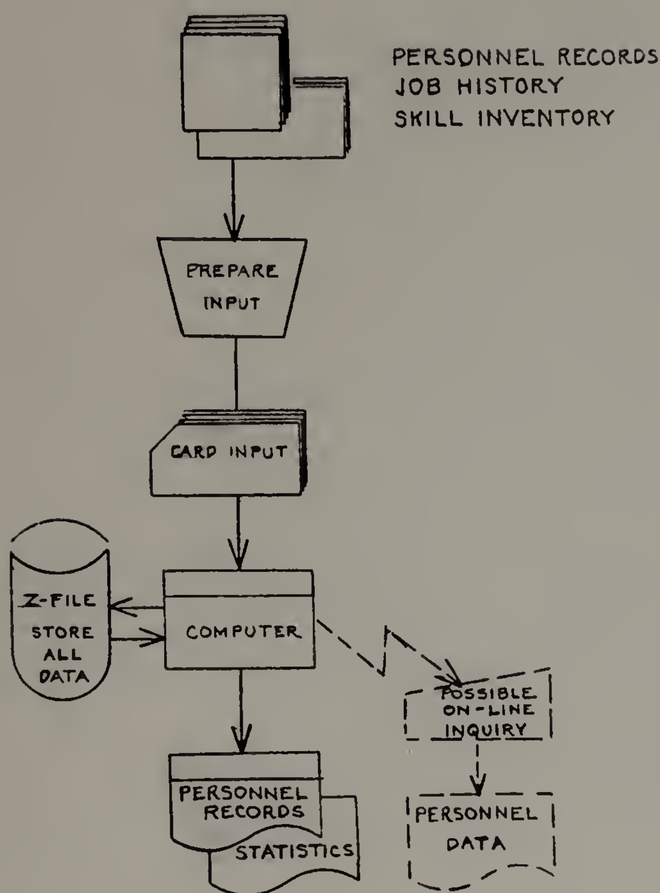
System:
FACULTY

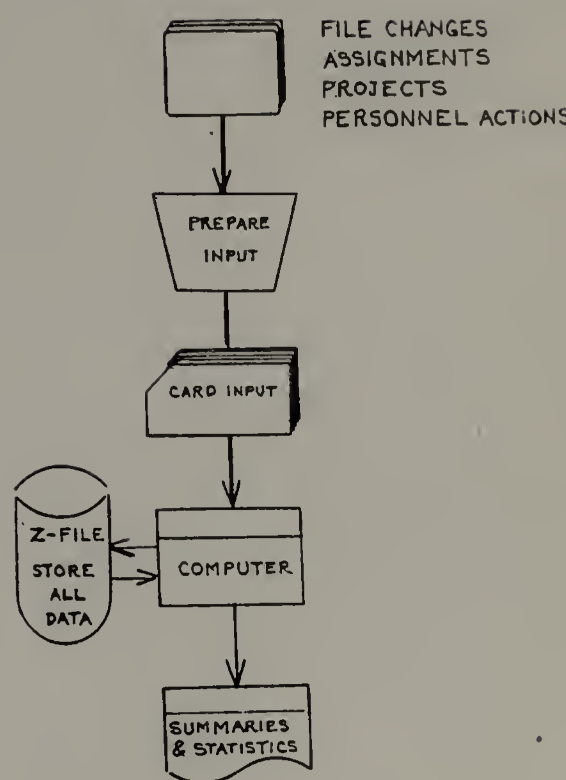




CONCEPTUAL DATA FLOW

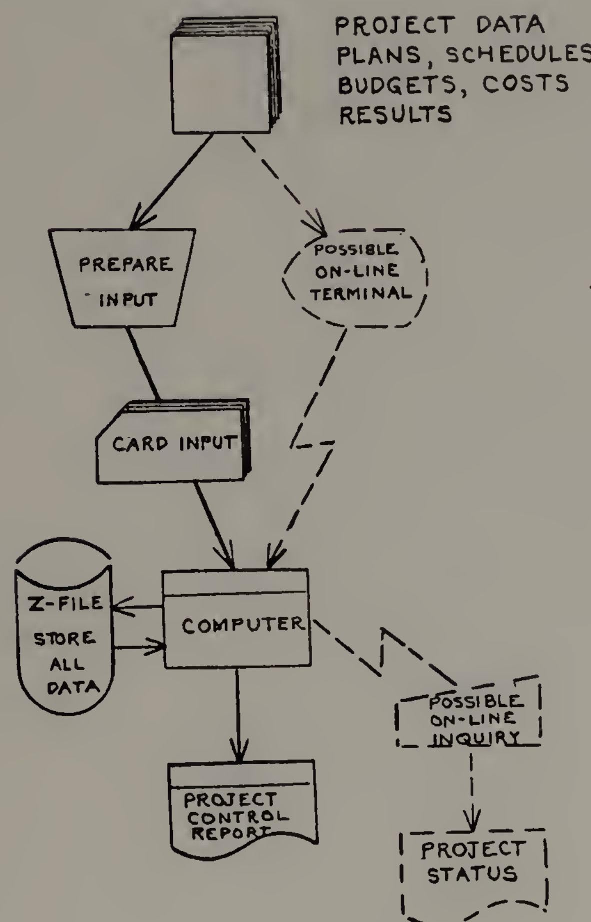
System: STAFF





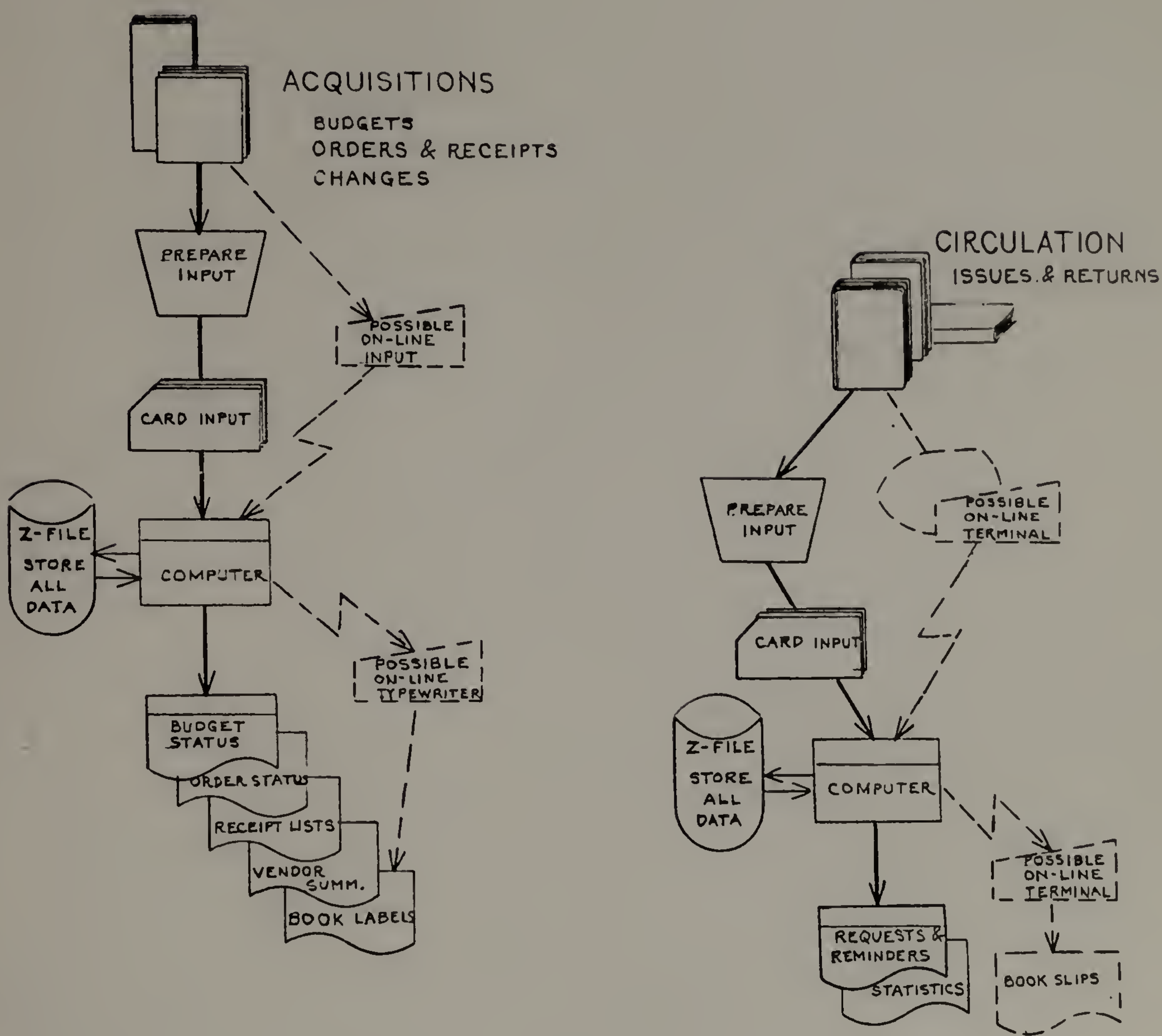
CONCEPTUAL DATA FLOW

System:
PROJECTS & PLANS



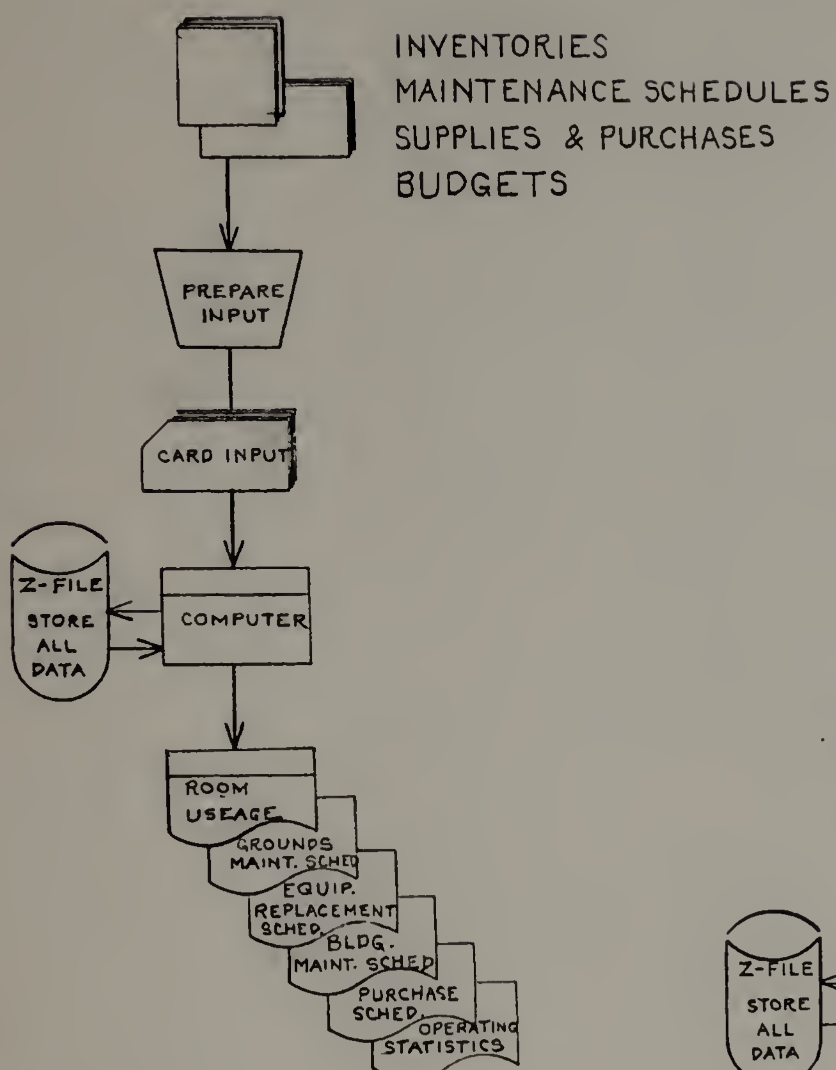
CONCEPTUAL DATA FLOW

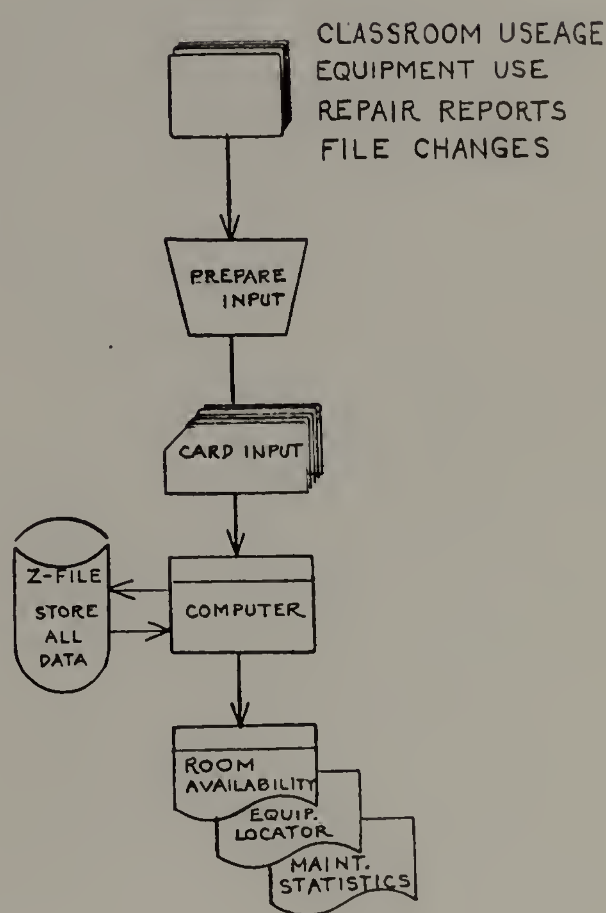
System: Subsystem:
PLANT ASSETS - LIBRARIES



CONCEPTUAL DATA FLOW

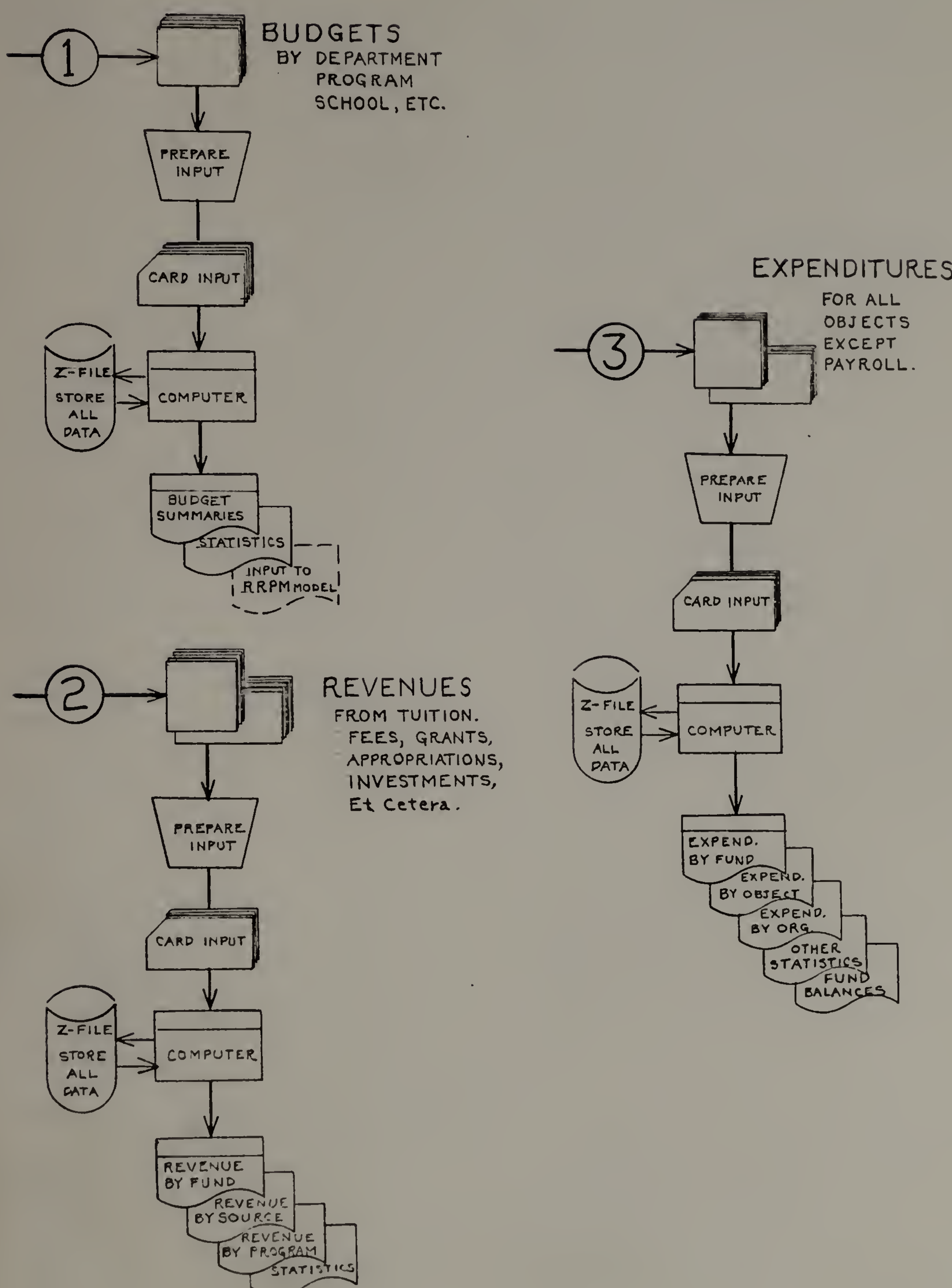
System: Subsystem:
PLANT ASSETS - BUILDINGS & EQUIPMENT





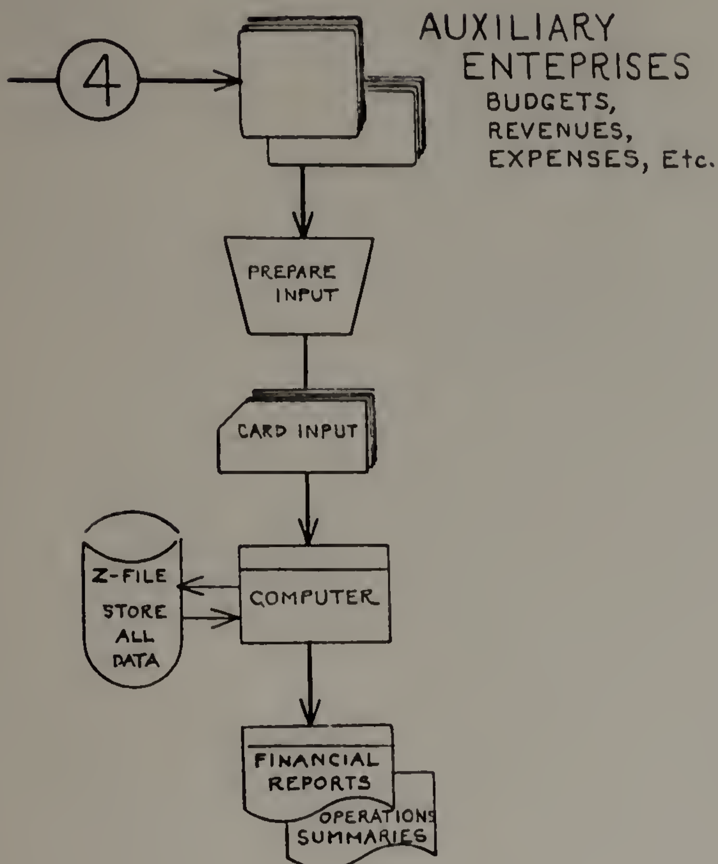
CONCEPTUAL DATA FLOW

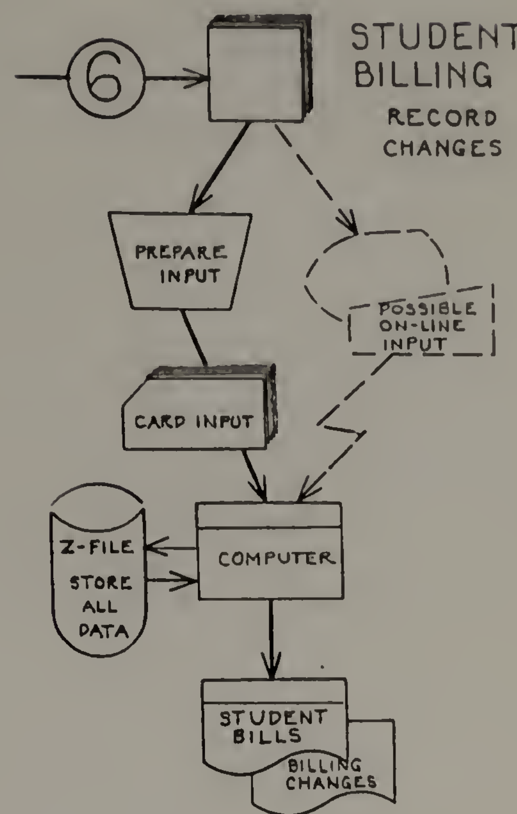
System:
FINANCIAL

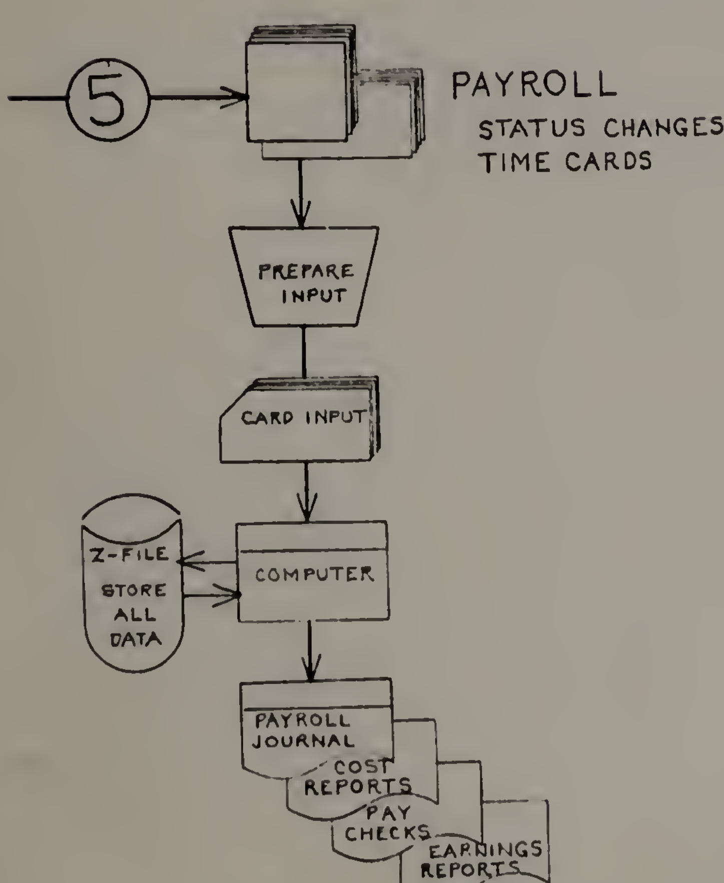


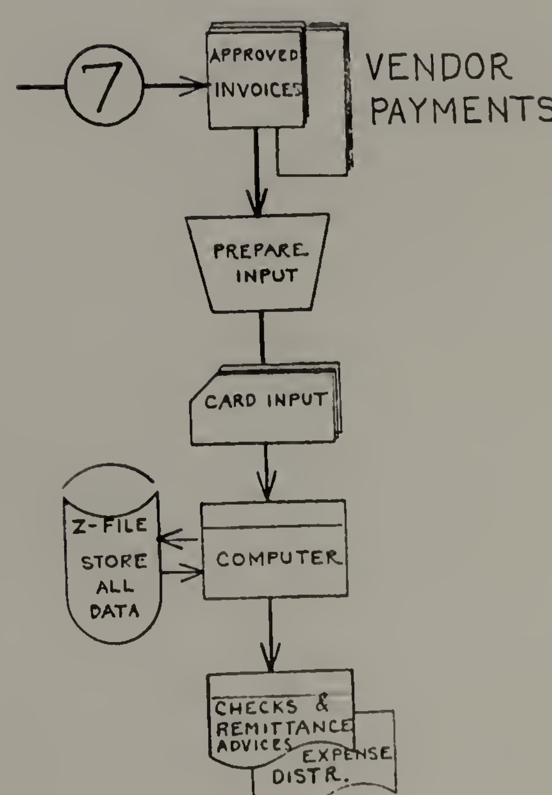
System:
FINANCIAL

CONCEPTUAL DATA FLOW









FORM SAMPLES

New or existing forms that are used by a particular institution form the basis for data input to the Z-file system. In most cases the system would be adapted to use existing forms where those forms are adequate for their purpose. Where they are not adequate, new forms should be designed and implemented.

The following form samples serve only as an illustration from which data may be shown to flow through the entire Z-file system. While the forms illustrated may embody certain design improvements, they are not meant to imply a limitation on the types of forms that may be used by the system.

The application form shown is self-explanatory. It was designed using several existing forms as models. It is the source of data items for the data card layouts and Z-file record layouts shown in the program documentation in this appendix.

The Interview Form illustrates an attempt to capture data relating to the recruiting effort in order to develop reports that will improve the effectiveness of recruiting. Data from this form is also illustrated on subsequent record layouts, Data Useage Forms and report samples.

The Planning Profile is a form that is intended to capture both personal data and course pre-registration data.

Application for admission

PLEASE TYPE OR PRINT

20 YOUR LAST NAME | HYPHENATE LAST NAME WITH MAIDEN OR OTHER LAST NAME ------- YES = X | SR JR III IV | SEMESTER YOU WISH TO ENTER JAN. JUN. SEPT. YEAR

MS MR | YOUR FIRST NAME | MIDDLE NAME | MAIDEN OR OTHER LAST NAME | YOUR DATE OF BIRTH MO. DAY YR.

CHECK (✓) IF YOU NORMALLY USE YOUR FIRST INITIAL AND YOUR FULL MIDDLE NAME.

YOUR SOCIAL SECURITY NO.

22 YOUR PERMANENT ADDRESS | CITY | COUNTY

STATE | NATION (IF OTHER THAN U.S. OF AMERICA) | CODE | ZIP CODE | AREA CODE | PHONE NO.

24 YOUR PRESENT MAIL ADDRESS – IF DIFFERENT FROM ABOVE | CITY | VALID UNTIL MO. DAY YR.

STATE | NATION | CODE | ZIP CODE | AREA CODE | PHONE NO.

26 MS MR DR | NEAREST RELATIVE GIVEN NAME: | INITIAL | LAST NAME | MAIL ADDRESS – IF DIFFERENT FROM PERMANENT ADDRESS

CITY | STATE | ZIP CODE | RELATIONSHIP PARENT SPOUSE BROTH.-SISTER GUARD. OTHER

28 CITIZEN OF: (NATION) | CODE | CHECK BRANCH IF VETERAN ARMY NAVY AF M.C. CG | DISCHARGE DATE MO. DAY YR. | TYPE | RANK AT DISCHARGE E or O LEVEL

EMPLOYED FULL-TIME MONTHS | FIELD OF WORK EXPER. | FULL-TIME WORK – POSITION HELD | CHECK IF MINORITY GROUP MEMBER BLACK ASIAN AMER. NATIVE AMER. SPAN. SUR.

YOUR FATHER: OCCUPATION LIVING NOW? NO | YOUR MOTHER: OCCUPATION LIVING NOW? NO | YOUR SPOUSE: OCCUPATION NONE | DEPENDENTS INCL. SELF | NEED FIN. ASSIST.? NO 1 2 3

30 STUDENT STATUS APPLIED FOR: U.S.-FRESH TFR. SPECIAL NON-DEG GRAD | WHAT DEGREE DO YOU SEEK? AA BA B.S. M.S. NONE | FULL-TIME? FULL PART EVENING | LIVE ON CAMPUS? YES NO

WILL YOU BE EMPLOYED WHILE A STUDENT | PLANNED DEPT. | MAJOR | ED. COMB. | CAREER INTEREST | HAVE YOU APPLIED BEFORE? IF YES, WHEN SEMESTER YR.

SOURCE OF YOUR INFO ABOUT THIS SCHOOL | TEST TAKEN: SAT TOEFL MO. YR. | TEST TAKEN: SAT TOEFL MO. YR.

SCHOOLS ATTENDED:

32 FROM MO. YR. | UNTIL MO. YR. | LEVEL H.S. COLL. | CODE | SCHOOL NAME | ADDRESS

CITY | STATE | ZIP | AREA CODE | PHONE NO. | MS MR DR COUNSELLOR LAST NAME | GRADE AVG

32 FROM MO. YR. | UNTIL MO. YR. | LEVEL H.S. COLL. | CODE | SCHOOL NAME | ADDRESS

CITY | STATE | ZIP | AREA CODE | PHONE NO. | MS MR DR COUNSELLOR LAST NAME | GRADE AVG

INTERVIEW FORM

INTERVIEWER NO.	INTERVIEWER NAME		DATE	
SCHOOL NO.	H.S. ☐ COL. ☐	SCHOOL NAME	CITY	STATE

STUDENT:

LAST NAME (10-22)	GIVEN NAME (23-31)	INITIAL ☐ x	MS ☐ 1 MR ☐ 2 JR ☐ 3	DATE OF BIRTH (34-39) MO DAY YEAR
MAIL ADDRESS (40-57)			CITY (58-70)	

STATE (71-72)	ZIP (73-77)	INTEREST	ENTRY	EVAL. (80)	PHONE NO.
OBSERVATIONS					

CODES:

PROGRAM INTEREST:		PROB. ENTRY:	EVALUATION:
1. BUSINESS	6. PHYS. SCI.	1. NEXT SEM.	1. OUTSTANDING
2. EDUCATION	7. POLY. SCI.	2. 2ND SEM.	2. ABOVE AVG.
3. ENGINEER	8. SOC. SCI.	3. 3RD SEM.	3. AVG.
4. FINE ARTS	9.	4. 4TH SEM.	4. SL. BELOW
5. LIB. ARTS	0. GRAD.	5. TRANSFER	5. DEF BELOW

ADVISOR:

LAST NAME (24-38)	GIVEN NAME (39)	INITIAL ☐ x	+1 MS ☐ 1 MR ☐ 2 DR ☐ 3 DEAN ☐ 4 ☐ 5 ☐ 6	POSITION
MAIL ADDRESS (43-60)	CITY (61-73)		STATE	ZIP (76-80)

ADVISOR POSITION CODE:
1. TEACHER
2. ADMIN.
3. COUNSELLOR
4. OTHER: ______

PLANNING PROFILE

PLEASE PRINT CLEARLY

DATE: MO. YEAR

20

YOUR LAST NAME 3	FIRST NAME 7	SOCIAL SECURITY NUMBER 8 9 10	YOUR AGE

YOUR LOCAL ADDRESS — NUMBER & STREET 11		TOWN 27	PHONE NUMBER 34	
EMMERGENCY CONTACT – NAME 41	STREET ADDRESS 52	CITY OR TOWN 69	STATE 78	RELATION 80

22

ARE YOU NOW MARRIED? 11 YES 1 NO 2		IF YES, SPOUSES' FIRST NAME 12		IS YOUR SPOUSE EMPLOYED? 20 YES 1 NO 2	HOW MANY CHILDREN? 21	
UNDERGRADUATE ADVISOR: NAME 22		SCHOOL 35		CITY 52	STATE 64	YOUR YEAR GRADUATED 66
YEARS ACTIVE MILITARY DUTY 68	SERVICE BRANCH 69	HIGHEST RANK 70 E OR O 1–12	STATE OR COUNTRY WHERE RAISED 72	FLUENT NON-ENGLISH LANGUAGES 75	YOUR MAIN INTERESTS 76	
YOUR MASTERS PROGRAM: 77 MBA 1 MSBA: ACCT. 2 FINANCE MKT. 4 MGT. SCI. PERS. 6 URBAN				PLAN TO COMPLETE PROGRAM: 78 MONTH: 1, 5 OR 8 YEAR		

24

HOW MANY YEARS FULL-TIME WORK EXPERIENCE? 11	YOUR MAIN FIELD OF WORK EXPERIENCE: 12	PRIMARY JOB FUNCTION: 22	
YOUR PREFERRED REGION OR CITY: 24	IN WHAT FIELD DO YOU PLAN TO WORK? 26	WHAT JOB FUNCTION MOST INTERESTS YOU? 36	
PLAN TO BE EMPLOYED WHILE IN THIS MASTERS PROGRAM? 46 NO PART-TIME FULL-TIME	EMPLOYED NOW? FIRM NAME: 47	FIRM LOCATION: 65	YOUR POSITION: 78

PREREQUISITES: 400 411 440 | 451 456 406 | 422 447 457

X = HAVE TAKEN COURSE OR THE EQUIVALENT.

COURSE PROGRAM:

	SEMESTER	COURSE NO. –					
26	1 11 MO. YR.	14	19	24	29	34	39
	2 44 MO. YR.	47	52	57	62	67	72
28	3 11 MO. YR.	14	19	24	29	34	39
	4 44 MO. YR.	47	52	57	62	67	72
30	5 11 MO. YR.	14	19	24	YOUR SIGNATURE		

THE DATA USEAGE FORM

Each item of data in the Z-file system must be fully described and controlled. The description of each data field within each data record is accomplished through the Data Useage Form. One or more pages of the Data Useage Form are used to record the data from each data source (such as a form or other media). The Data Useage Form is used to record the data from each item of media in the same sequence as the data appears on the media. If the design of the media changes in terms of data content or sequence, the Data Useage Form must also be changed.

Each data item is identified on the Data Useage Form by a common description and by a technical COBOL data-name. The COBOL data-name (along with the related record code) becomes the permanent identifier of that data item in the Z-file system.

On the Data Useage Form each data item is described relating to its position on the input data record (this is the actual data record that is used for input to the main input edit program). Also shown is the position of the data on the output file of the edit program and on the Z-file. The actual print format of the data is defined, and any codes are also defined in terms of the code and its meaning.

In this manner, a detailed control record is developed that contains all necessary parameters to control the flow of data through the Z-file system.

The information on the Data Useage Form is to be key-punched into cards and read into the computer files through the Shadow System input conversion program.

The Shadow System places the data from the Data Useage Form onto either or both the Data Map and the Data-name Dictionary files. The Data Dictionary is also printed by the Shadow System. This Dictionary is used by programmers and other users to assist in preparing report print programs. The Data Map and Data-name Dictionary files are subsequently used to control the data flow through all operating-level programs.

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE		
STUDENT	1	ADMISSIONS	1	INQUIRIES		
CONTROL FIELDS A (7 ALPHA-NUM.) SHORT-NAME		B (10 PACKED DECIMAL) ZIP-CODE (5p)		NAME OF ANALYST: KAISER	DATE MO DAY YR: 9/20/76	PAGE 1 OF 1
FILE CONVERSION SOURCE: CARD [X] TAPE [ ]	RECORD LENGTH	BLOCK :1	FILE IDENTIFICATION	HEADER LABEL FORMAT		

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	FIELD	SIZE	DECIMAL PICTURE OR REMARKS
1		002		INQUIRIES-RECORD	01				
2	LAST NAME	002	4-18	LAST-NAME	03	002	-	-	
3	SHORT LAST NAME	"	4- 8	SHORT-LAST-NAME	05	"	4	5A	
4	LAST NAME REMAINDER	"	9-18	LAST-NAME-REMAIN	05	"	18	10A	
5	TITLE	"	19	TITLE	03	"	28	1S	CODE
6		"		TITLE-IS-MS	88	"			1,-1
7		"		TITLE-IS-MR	88	"			2,-2
8		"		TITLE-NEGATIVE	88	"			-1 THRU -9
9	GIVEN NAME	"	20-33	GIVEN-NAME	03	"	-	-	
10	FIRST INITIAL	"	20	FIRST-INITIAL	05	"	9	1A	
11	GIVEN NAME REMAINDER	"	21-33	GIVEN-NAME-REM	05	"	20	13A	
12	INITIAL	"	34	INITIAL	03	"	10	1A	
13	ADDRESS	"	35-54	ADDRESS	03	"	42	20A	
14	CITY	"	57-69	CITY	03	"	62	13A	
15	STATE	"	70-71	STATE	03	"	75	2A	
16	ZIP CODE	"	72-76	ZIP-CODE	03	"	13	5P	
17	OTHER NATION	"	77-79	OTHER-NATION	03	"	77	3A	NATION TAB
18	PROGRAM INTEREST	"	80	PROGRAM-INTEREST	03	"	80	1X	CODE
19		"		INT-IS-BIOLOGY	88	"			A
21		"		INT-IS-BOTANY	88	"			B
22		"		INT-IS-BUSINESS	88	"			D
23		"		INT-IS-CHEMISTRY	88	"			F
24		"		INT-IS-EDUCATION	88	"			H
25		"		INT-IS-ENGINEERING	88	"			J
26		"		INT-IS-LIBERAL-ARTS	88	"			L
27		"		INT-IS-MATHEMATICS	88	"			M

PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM: STUDENT	CODE: 1	SUBSYSTEM: ADMISSIONS	CODE: 1	DATA SOURCE: INTERVIEW FORM	
CONTROL FIELDS: A (7 ALPHA-NUM) SHORT-NAME	B (10 PACKED DECIMAL) SCHOOL CODE (4P)	DATE OF BIRTH (6P)	NAME OF ANALYST: KAISER	DATE MO DAY YR: 9/30/76	PAGE 1 OF 3
FILE CONVERSION SOURCE: CARD [X] TAPE [ ]	RECORD LENGTH	BLOCK: :1	FILE IDENTIFICATION	HEADER LABEL FORMAT	

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1		006		INTERVIEWS_REC	01				
2	INTERVIEWER CODE	006	4- 5	INTERVIEWER	03	006	76	2X	
3	SCHOOL CODE	"	6- 9	SCHOOL-CODE	03	"	11	4P	
4	STUDENT LAST NAME	"	10-22	LAST-NAME	03	"	-	-	
5	SHORT LAST NAME	"	11-15	SHORT-LAST-NAME	05	"	4	5A	
6	LAST NAME REMAINDER	"	16-22	LAST-NAME-REM	05	"	18	8A	
7	GIVEN NAME	"	23-31	GIVEN-NAME	03	"	-	-	
8	FIRST INITIAL	"	23	FIRST-INITIAL	05	"	9	1A	
9	GIVEN NAME REMAINDER	"	24-31	GIVEN-NAME-REM	05	"	26	8A	
10	INITIAL	"	32	INITIAL	03	"	10	1A	
11	TITLE	"	33	TITLE	03	"	34	1S	CODE
12		"		TITLE-NEGATIVE	88	"			-1 THRU -9
13		"		TITLE-IS-MS	88	"			1,-1
14		"		TITLE-IS-MR	88	"			2,-2
15		"		TITLE-IS-JUNIOR	88	"			4,-4
16		"		TITLE-IS-THIRD	88	"			6,-6
17	DATE OF BIRTH	"	34-39	DATE-OF-BIRTH	03	"	13	6P	
18	MAIL ADDRESS	"	40-57	MAIL-ADDRESS	03	"	35	18A	
19	CITY	"	58-70	CITY	03	"	53	13A	
21	STATE	"	71-72	STATE	03	"	66	2A	
22	ZIP CODE	"	73-77	ZIP-CODE	03	"	68	5N	
23	PROGRAM INTEREST	"	78	PROGRAM-INTEREST	03	"	73	1X	CODE
24		"		INT-IS-BIOLOGY	88	"			A
25		"		INT-IS-BOTANY	88	"			B
26		"		INT-IS-BUSINESS	88	"			D
27		"		INT-IS-CHEMISTRY	88	"			F

PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM: STUDENT | CODE: 1 | SUBSYSTEM: ADMISSIONS | CODE: 1 | DATA SOURCE: INTERVIEW FORM

CONTROL FIELDS: A (7 ALPHA-NUM.) B (10 PACKED DECIMAL)

NAME OF ANALYST: KAISER | DATE (MO DAY YR): 9 30 / 76 | PAGE 2 OF 3

FILE CONVERSION SOURCE: CARD [X] TAPE [ ]

RECORD LENGTH | BLOCK :1 | FILE IDENTIFICATION | HEADER LABEL FORMAT

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME / 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	SIZE	DECIMAL PICTURE OR REMARKS
1		006		INT-IS-EDUCATION	88	006			H
2		"		INT-IS-ENGINEERING	88	"			J
3		"		INT-IS-LIBERAL-ARTS	88	"			L
4		"		INT-IS-MATHEMATICS	88	"			M
5	DESIRED ENTRY PERIOD	"	79	DESIRED-ENTRY	03	"	74	1A	CODE
6		"		ENTRY-NEXT-FALL	88	"			A
7		"		ENTRY-NEXT-SPRING	88	"			B
8		"		ENTRY-NEXT-SUMMER	88	"			C
9		"		ENTRY-2ND-FALL	88	"			D
10		"		ENTRY-2ND-SPRING	88	"			E
11		"		ENTRY-2ND-SUMMER	88	"			F
12	INTERVIEWER'S IMPRESSION	"	80	IMPRESSION	03	"	75	1N	CODE
13		"		IMPRES-OUTSTANDING	88	"			1
14		"		IMPRES-VERY-FAVOR	88	"			2
15		"		IMPRES-FAVORABLE	88	"			3
16		"		IMPRES-SO-SO	88	"			4
17		"		IMPRES-NEGATIVE	88	"			5
18									
19									
21									
22									
23									
24									
25									
26									
27									

PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE
STUDENT	1	ADMISSIONS	1	INTERVIEW FORM (ADVISOR)

CONTROL FIELDS: A (7 ALPHA-NUM.) SHORT-NAME; B (10 PACKED DECIMAL) INTERVIEWER CODE (2P); SCHOOL CODE (4P)

NAME OF ANALYST: KAISER — DATE MO DAY YR: 9/30/ 76 — PAGE 3 OF 3

FILE CONVERSION SOURCE: CARD [X] TAPE [ ] — RECORD LENGTH — BLOCK :1 — FILE IDENTIFICATION — HEADER LABEL FORMAT

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1		008		INT-ADVISOR	01				
2	INTERVIEWER CODE	008	4- 5	INTERVIEWER	03	008	11	2P	
3	SCHOOL CODE	"	6- 9	SCHOOL-CODE	03	"	14	4P	
4	STUDENT LAST NAME	"	10-22	LAST-NAME	03	"	-	-	
5	SHORT LAST NAME	"	11-15	SHORT-LAST-NAME	05	"	4	5A	
6	LAST NAME REMAINDER	"	16-22	LAST-NAME-REM	05	"			
7	STUDENT FIRST INITIAL	"	23	FIRST-INITIAL	03	"	9	1A	
8	ADVISOR LAST NAME	"	24-38	ADVISOR-LAST-NAME	03	"	18	15A	
9	ADVISOR FIRST INITIAL	"	39	ADVIS-FIRST-INITIAL	03	"	33	1A	
10	ADVISOR MIDDLE INITIAL	"	40	ADVIS-MID-INITIAL	03	"	34	1A	
11	TITLE OF ADVISOR	"	41	ADVISORS-TITLE	03	"	35	1N	CODE
12		"		TITLE-IS-MS	88	"			1
13		"		TITLE-IS-MR	88	"			2
14		"		TITLE-IS-DR	88	"			7
15		"		TITLE-IS-DEAN	88	"			8
16		"		TITLE-IS-REV	88	"			9
17	ADVISOR MAIL ADDRESS	"	43-60	MAIL-ADDRESS	03	"	37	18A	
18	ADVISOR POSITION CODE	"	42	ADVISOR-POSITION	03	"	36	1X	CODE
19		"		POSITION-FACULTY	88	"			1
21		"		POSITION-ADMIN	88	"			2
22		"		POSITION-STAFF-COUN	88	"			3
23		"		POSITION-STAFF-OTHER	88	"			4
24		"		POSITION-OTHER	88	"			5
25	ADVISOR CITY	"	61-73	ADVISOR-CITY	03	"	55	13A	
26	STATE	"	71-72	STATE	03	"	68	2A	
27	ZIP CODE	"	76-80	ZIP-CODE	03	"	70	5N	

PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE		
STUDENT	1	ADMISSIONS	1	ROSTER OF SCHOOLS		
CONTROL FIELDS A (7 ALPHA-NUM) SCHOOL-SHORT-NAME B (10 PACKED DECIMAL) SCHOOL CODE (4P)		DIVISION (2P)		NAME OF ANALYST KAISER	DATE MO DAY YR 10/01/76	PAGE 1 OF 3
FILE CONVERSION SOURCE: CARD [X] TAPE [ ]	RECORD LENGTH	BLOCK :1	FILE IDENTIFICATION	HEADER LABEL FORMAT		

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1		012		SCHOOL-NAME-RECORD	01				
2	SCHOOL CODE	012	4- 7	SCHOOL-CODE	03	012	11	4P	
3	SCHOOL DIVISION CODE	"	8- 9	SCHOOL-DIVISION	03	"	13	2P	
4	SCHOOL SHORT NAME	"	10-16	SCHOOL-SHORT-NAME	03	"	4	7A	
5	SCHOOL NAME	"	18-52	SCHOOL-NAME	03	"	18	35A	
6	SCHOOL DIVISION NAME	"	53-77	DIVISION-NAME	03	"	53	25A	
7	SCHOOL SIZE CODE	"	78	DIV -SIZE-CODE	03	"	78	1X	CODE
8		"		SIZE-BELOW-100	88	"			1
9		"		SIZE-101-300	88	"			2
10		"		SIZE-301-700	88	"			3
11		"		SIZE-701-1000	88	"			4
12		"		SIZE-1001-2000	88	"			5
13		"		SIZE-2001-4000	88	"			6
14		"		SIZE-4001-6000	88	"			7
15		"		SIZE-6001-10000	88	"			8
16		"		SIZE-10001-25000	88	"			9
17		"		SIZE-ABOVE-25000	88	"			A
18	ACCREDITATION CODE	"	79	DIV-ACCREDITATION	03	"	79	1X	CODE
19		"		ACCRED-AACSB	88	"			1
21		"		ACCRED-NEA	88	"			2
22		"		ACCRED-WECP	88	"			3
23		"		ACCRED-AMA	88	"			4
24	PROGRAMS OFFERED	"	80	PROGRAMS-OFFERED	03	"	80	1X	CODE
25		"		PROG-GENERAL	88	"			1
26		"		PROG-COLLEGE-GEN	88	"			2
27									

PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE
STUDENT	1	ADMISSIONS	1	ROSTER OF SCHOOLS

CONTROL FIELDS: A (7 ALPHA-NUM) B (10 PACKED DECIMAL) SCHOOL CODE (4P) ZIP CODE (5P)

NAME OF ANALYST: KAISER | DATE MO DAY YR: 10/ 1/76 | PAGE 2 OF 3

FILE CONVERSION SOURCE: CARD [X] TAPE [ ] | RECORD LENGTH | BLOCK :1 | FILE IDENTIFICATION | HEADER LABEL FORMAT

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1		014		SCHOOL-ADDRESS-REC	01				
2	SCHOOL CODE	014	4- 7	SCHOOL-CODE	03	014	11	4P	
3	SCHOOL MAIL ADDRESS	"	18-39	SCHOOL-ADDRESS	03	"	18	22A	
4	SCHOOL CITY	"	40-52	CITY	03	"	40	13A	
5	SCHOOL COUNTY	"	53-60	COUNTY	03	"	53	8A	
6	SCHOOL STATE	"	61-62	STATE	03	"	61	2A	
7	SCHOOL NATION	"	63-65	NATION	03	"	63	3A	
8	ZIP CODE	"	66-70	ZIP-CODE	03	"	13	5P	
9	SCHOOL AREA CODE	"	71-73	AREA-CODE	03	"	66	3N	
10	SCHOOL PHONE NUMBER	"	74-80	PHONE-NUMBER	03	"	69	7N	
11									
12									
13									
14									
15									
16									
17									
18									
19									
21									
22									
23									
24									
25									
26									
27									

PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE		
STUDENT	1	ADMISSIONS	1	ROSTER OF SCHOOLS		
CONTROL FIELDS A (7 ALPHA-NUM.)		B (10 PACKED DECIMAL) SCHOOL CODE (4P)	SEQUENCE NO. (2P)	NAME OF ANALYST KAISER	DATE MO DAY YR 10/1/76	PAGE 3 OF 3
FILE CONVERSION SOURCE: CARD [X] TAPE [ ]	RECORD LENGTH	BLOCK :1	FILE IDENTIFICATION	HEADER LABEL FORMAT		

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1		016		SCHOOL-PERSONNEL -REC	01				
2	SCHOOL CODE	016	4- 7	SCHOOL-CODE	03	016	11	4P	
3	RECORD SEQUENCE NUMBER	"	8- 9	SEQUENCE-NO	03	"	13	2P	
4	TITLE OF PERSON	"	18-	TITLE	03	"	18	1X	CODE
5		"		TITLE-IS-MS	88	"			1
6		"		TITLE-IS-MR	88	"			2
7		"		TITLE-IS-DR	88	"			7
8		"		TITLE-IS-DEAN	88	"			8
9		"		TITLE-IS-REV	88	"			0
10		"		TITLE-IS-PRESIDENT	88	"			A
11		"		TITLE-IS-CHANCELLOR	88	"			B
12		"		TITLE-IS-PROFESSOR	88	"			C
13	GIVEN NAME OF PERSON	"	19-32	GIVEN-NAME	03	"	19	14A	
14	INITIAL OF PERSON	"	33	INITIAL	03	"	33	1A	
15	LAST NAME OF PERSON	"	34-48	LAST-NAME	03	"	34	15A	
16	JUNIOR, SENIOR OR THIRD	"	49	JR-SR-THIRD	03	"	49	1N	CODE
17	(code for placing the initial first, then given name)	"		JR-SR-IS-NEGATIVE	88	"			-1 THRU -9
18		"		JUNIOR	88	"			4
19		"		SENIOR	88	"			5
21		"		THE-THIRD	88	"			6
22		"		THE-FOURTH	88	"			7
23	POSITION NAME OF PERSON	"	50-73	POSITION-NAME	03	"	50	24A	
24	TELEPHONE NUMBER	"	74-80	PHONE-NUMBER	03	"	74	7N	
25									
26									
27									

PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE
STUDENT	1	ADMISSIONS	1	APPLICATION

CONTROL FIELDS: A (7 ALPHA-NUM) SHORT-NAME; B (10 PACKED DECIMAL) SOCIAL-SECURITY-NO

NAME OF ANALYST	DATE (MO DAY YR)	PAGE	OF
KAISER	10/2/76	1	13

FILE CONVERSION SOURCE: CARD [X] TAPE [ ]

RECORD LENGTH	BLOCK	FILE IDENTIFICATION	HEADER LABEL FORMAT
	:1		

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME / 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1		020		APPLICATION-NAME-REC	01				
2	SOCIAL SECURITY NUMBER	020	4-12	SOCIAL-SECURITY-NO	03	020	11	9P	
3	STUDENT LAST NAME	"	13-27	LAST-NAME	03	"	-	-	
4	SHORT LAST NAME	"	13-17	SHORT-LAST-NAME	05	"	4	5A	
5	LAST NAME REMAINDER	"	18-27	LAST-NAME-REM	05	"	10	10A	
6	STUDENT TITLE (MS or MR)	"	28	TITLE	03	"	18	1N	CODE
7		"		TITLE-IS-MS	88	"			1,-1
8		"		TITLE-IS-MR	88	"			2,-2
9	(If field is negative use first initial & middle name)			USE-INITIAL-FIRST	88	"			-1 THRU -9
10	STUDENT FIRST NAME	"	29-42	FIRST-NAME	03	"	-	-	
11	INITIAL OF FIRST NAME	"	29	FIRST-INITIAL	05	"	9	1A	
12	REMAINDER OF 1ST NAME	"	30-42	FIRST-NAME-REM	05	"	30	13A	
13	STUDENT MIDDLE NAME	"	43-56	MIDDLE-NAME	03	"	-	-	
14	MIDDLE INITIAL	"	43	MIDDLE-INITIAL	05	"	10	1A	
15	MIDDLE NAME REMAINDER	"	44-56	MIDDLE-NAME-REM	05	"	42	13A	
16	JUNIOR, SENIOR OR THIRD	"	57	JR-SR-THIRD	03	"	55	1N	CODE
17		"		JUNIOR	88	"			4,-4
18		"		SENIOR	88	"			5,-5
19		"		THE-THIRD	88	"			6,-6
21		"		THE-FOURTH	88	"			7,-7
22	(If field is negative, hyphenate last name)	"		JR-SR-NEGATIVE	88	"			-1 THRU -9
23	STUDENT OTHER LAST NAME	"	58-70	OTHER-LAST-NAME	03	"	56	13A	
24	STUDENT DATE OF BIRTH	"	71-76	DATE-OF-BIRTH	03	"	-	-	
25	MONTH IN DATE OF BIRTH	"	71-72	BIRTHDATE-MONTH	05	"	69	2N	
26	DAY IN DATE OF BIRTH	"	73-74	BIRTHDATE-DAY	05	"	71	2N	
27	YEAR IN DATE OF BIRTH	"	75-76	BIRTHDATE-YEAR	05	"	73	2N	

PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE		
STUDENT	1	ADMISSIONS	1	APPLICATION		
CONTROL FIELDS: A (7 ALPHA-NUM)		B (10 PACKED DECIMAL)		NAME OF ANALYST: KAISER	DATE (MO DAY YR): 10/ 1/ 76	PAGE 2 OF 13
FILE CONVERSION SOURCE: CARD [X] TAPE [ ]	RECORD LENGTH	BLOCK :1	FILE IDENTIFICATION	HEADER LABEL FORMAT		

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1	DESIRED ENTRY DATE	020	77-79	DESIRED-ENTRY	03	020	-	-	
2	SEMESTER DESIRED ENTRY	"	77	SEMESTER-DESIRED	05	"	75	1X	
3	YEAR OF DESIRED ENTRY	"	78-79	YEAR-DESIRED	05	"	76	2N	
4									
5									
6									
7									
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27									

PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE
STUDENT	1	ADMISSIONS	1	APPLICATION

CONTROL FIELDS			NAME OF ANALYST	DATE (MO DAY YR)	PAGE OF
A (7 ALPHA-NUM)	B (10 PACKED DECIMAL)	SOCIAL-SECURITY-NO	KAISER	10 / 2/76	3 13

FILE CONVERSION SOURCE:	RECORD LENGTH	BLOCK	FILE IDENTIFICATION	HEADER LABEL FORMAT
CARD [X] TAPE [ ]		:1		

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1		022		APP-PERM-ADDRESS-REC	01				
2	SOCIAL SECURITY NUMBER	022	4-12	SOCIAL-SECURITY-NO	03	022	11	9P	
3	STUDENT PERMANENT RESIDENCE	"	13-34	PERMANENT-ADDRESS	03	"	18	22A	
4	RESIDENCE CITY	"	35-47	CITY	03	"	40	13A	
5	COUNTY OF RESIDENCE	"	48-55	COUNTY	03	"	53	8A	
6	STATE OF RESIDENCE	"	56-57	STATE	03	"	61	2A	
7	NATION OF RESIDENCE	"	58-60	NATION	03	"	62	3A	
8	ZIP CODE	"	61-65	ZIP-CODE	03	"	66	5N	
9	TELEPHONE AREA CODE	"	66-68	AREA-CODE	03	"	71	3N	
10	TELEPHONE NUMBER	"	69-75	PHONE-NUMBER	03	"	74	7N	
11									
12									
13									
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PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE
STUDENT	1	ADMISSIONS	1	APPLICATION

CONTROL FIELDS: A (7 ALPHA-NUM) B (10 PACKED DECIMAL) SOCIAL-SECURITY-NO

NAME OF ANALYST: KAISER — DATE (MO DAY YR): 10/3/76 — PAGE 4 OF 13

FILE CONVERSION SOURCE: CARD [X] TAPE [ ] — RECORD LENGTH: — BLOCK: 1 — FILE IDENTIFICATION: — HEADER LABEL FORMAT:

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME / 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1		024		APP-PRESENT-ADDRESS-REC	01				
2	SOCIAL SECURITY NUMBER	024	4-12	SOCIAL-SECURITY-NO	03	024	11	0P	
3	STUDENT MAILING ADDRESS	"	13-34	MAIL-ADDRESS	03	"	18	22A	
4	PRESENT CITY	"	35-47	CITY	03	"	40	13A	
5	DATE UNTIL VALID	"	50-55	DATE-VALID-UNTIL	03	"	-	-	
6	MONTH IN VALID DATE	"	50-51	MONTH-IN-DATE	05	"	55	2N	
7	DAY IN VALID DATE	"	52-53	DAY-IN-DATE	05	"	57	2N	
8	YEAR IN VALID DATE	"	54-55	YEAR-IN-DATE	05	"	59	2N	
9	STATE	"	56-57	STATE	03	"	61	2A	
10	NATION	"	58-60	NATION	03	"	63	3A	
11	ZIP CODE	"	61-65	ZIP-CODE	03	"	66	5N	
12	TELEPHONE AREA CODE	"	66-68	AREA-CODE	03	"	71	3N	
13	TELEPHONE NUMBER	"	69-75	PHONE-NUMBER	03	"	74	7N	
14									
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PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE			
STUDENT	1	ADMISSIONS	1	APPLICATION			
CONTROL FIELDS A (7 ALPHA-NUM)		B (10 PACKED DECIMAL) SOCIAL-SECURITY-NO		NAME OF ANALYST KAISER	DATE MO DAY YR 10/3/76	PAGE 5	OF 13
FILE CONVERSION SOURCE: CARD [X] TAPE [ ]	RECORD LENGTH	BLOCK :1	FILE IDENTIFICATION	HEADER LABEL FORMAT			

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1		026		APP-RELATION-REC	01				
2	SOCIAL SECURITY NUMBER	026	4-12	SOCIAL-SECURITY-NO	03	026	11	9P	
3	TITLE OF RELATION	"	13	TITLE	03	"	18	1N	CODE
4	(If field negative, use initial first)	"		TITLE-INITIAL-FIRST	88	"			-1 THRU -9
5		"		TITLE-IS-MS	88	"			1,-1
6		"		TITLE-IS-MR	88	"			2,-2
7		"		TITLE-IS-DR	88	"			7,-7
8	RELATION GIVEN NAME	"	14-22	GIVEN-NAME	03	"	19	9A	
9	INITIAL	"	23	INITIAL	03	"	28	1A	
10	LAST NAME OF RELATION	"	24-36	LAST-NAME	03	"	29	13A	
11	MAILING ADDRESS	"	37-54	ADDRESS	03	"	42	18A	
12	CITY	"	55-67	CITY	03	"	60	13A	
13	STATE	"	68-69	STATE	03	"	73	2A	
14	ZIP CODE	"	70-74	ZIP-CODE	03	"	75	5N	
15	RELATIONSHIB CODE	"	75	RELATIONSHIP	03	"	80	1N	CODE
16		"		RELATION-PARENT	88	"			1
17		"		RELATION-SPOUSE	88	"			2
18		"		RELATION-FILIAL	88	"			3
19		"		RELATION-GUARDIAN	88	"			4
21		"		RELATION-OTHER	88	"			5
22									
23									
24									
25									
26									
27									

PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE		
STUDENT	1	ADMISSIONS	1	APPLICATION		
CONTROL FIELDS: A (7 ALPHA-NUM.)		B (10 PACKED DECIMAL) SOCIAL-SECURITY-NO		NAME OF ANALYST: KAISER	DATE MO DAY YR: 10/4/76	PAGE 6 OF 13
FILE CONVERSION SOURCE: CARD [X] TAPE [ ]	RECORD LENGTH	BLOCK :1	FILE IDENTIFICATION	HEADER LABEL FORMAT		

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1		028		APP-OTHER-DATA-REC	01				
2	SOCIAL SECURITY NUMBER	028	4-12	SOCIAL-SECURITY-NO	03	028	11	0P	
3	CITIZEN OF (NATION)	"	13-15	CITIZEN-OF	03	"	18	3A	
4	VISA TYPE, IF FOREIGN	"	16	VISA-TYPE	03	"	21	1N	CODE
5		"		VISA-IS-F1	88	"			1
6									
7									
8		"		VISA-IS-OTHER	88	"			9
9	SERVICE BRANCH, IF VETERAN	"	17	SERVICE-BRANCH	03	"	22	1N	CODE
10		"		SERVICE-AIR-FORCE	88	"			1
11		"		SERVICE-ARMY	88	"			2
12		"		SERVICE-COASTGUARD	88	"			3
13		"		SERVICE-MARINES	88	"			4
14		"		SERVICE-NAVY	88	"			5
15	DISCHARGE DATE	"	18-23	DISCHARGE-DATE	03	"	-	-	
16	MONTH IN DISCHARGE DATE	"	18-19	MONTH-IN-DATE	05	"	23	2N	
17	DAY IN DISCHARGE DATE	"	20-21	DAY-IN-DATE	05	"	25	2N	
18	YEAR IN DISCHG DATE	"	22-23	YEAR-IN-DATE	05	"	27	2N	
19	TYPE OF DISCHARGE	"	24	TYPE-OF-DISCHARGE	03	"	29	1N	
21		"		TYPE-IS-HONORABLE	88	"			1
22		"		TYPE-IS-GENERAL	88	"			2
23		"		TYPE-IS-OTHER	88	"			3
24	SERVICE RANK	"	25	RANK	03	"	30	1N	
25		"		RANK-IS-OFFICER	88	"			-1 THRU -9
26		"		RANK-IS-ENLISTED	88	"			1 THRU 9
27	MONTHS OF FULL-TIME EMPL.	"	26-27	MONTHS-EMPLOYED	03	"	31	2N	

PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE
STUDENT	1	ADMISSIONS	1	APPLICATION

CONTROL FIELDS: A (7 ALPHA-NUM.) B (10 PACKED DECIMAL) SOCIAL-SECURITY-NO

NAME OF ANALYST: KAISER — DATE (MO DAY YR): 10/4/76 — PAGE 7 OF 13

FILE CONVERSION SOURCE: CARD [X] TAPE [ ] — RECORD LENGTH: — BLOCK: :1 — FILE IDENTIFICATION: — HEADER LABEL FORMAT:

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME / 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1	FIELD OF WORK EXPERIENCE	028	28-35	FIELD-OF-WORK	03	028	33	8A	
2	HIGHEST WORK POSITION HELD	"	36-41	WORK-POSITION	03	"	41	6A	
3	MINORITY GROUP CODE	"	42-43	MINORITY	03	"	47	2A	
4	FATHER'S OCCUPATION	"	44-53	FATHER-OCCUPATION	03	"	49	10A	
5	MOTHER'S OCCUPATION	"	54-63	MOTHER-OCCUPATION	03	"	59	10A	
6	SPOUSES OCCUPATION	"	64-72	SPOUSE-OCCUPATION	03	"	69	9A	
7	(includes self) NUMBER OF DEPENDENTS	"	73	NO-OF-DEPEND	03	"	78	1N	
8	REQUESTING FINANCIAL AID	"	74-75	FIN-AID-REQUESTED	03	"	79	2N	
9									
10									
11									
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PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE		
STUDENT	1	ADMISSIONS	1	APPLICATION		
CONTROL FIELDS A (7 ALPHA-NUM)		B (10 PACKED DECIMAL) SOCIAL-SECURITY-NO		NAME OF ANALYST: KAISER	DATE MO DAY YR: 10/4/76	PAGE 8 OF 13
FILE CONVERSION SOURCE: CARD [X] TAPE [ ]	RECORD LENGTH	BLOCK :1	FILE IDENTIFICATION	HEADER LABEL FORMAT		

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1		030		APP-TESTS-STATUS-REC	01				
2	SOCIAL SECURITY NUMBER	030	4-12	SOCIAL-SECURITY-NO	03	030	11	9P	
3	STUDENT STATUS DESIRED	"	13	STATUS-CODE	03	"	18	1N	CODE
4		"		STATUS-UNDERGRAD-FR	88	"			1
5		"		STATUS-UNDERGRAD-TFR	88	"			2
6		"		STATUS-SPECIAL-UG	88	"			3
7		"		STATUS-NON-DEGREE	88	"			4
8		"		STATUS-GRADUATE	88	"			5
9	DEGREE SOUGHT, IF ANY	"	14	DEGREE-GOAL	03	"	19	1N	CODE
10		"		GOAL-AA	88	"			1
11		"		GOAL-BA	88	"			2
12		"		GOAL-BS	88	"			3
13		"		GOAL-MS	88	"			4
14		"		GOAL-NON-DEGREE	88	"			5
15	FULL TIME/ PART TIME	"	15	FULL-TIME	03	"	20	1N	CODE
16		"		TIME-FULL	88	"			1
17		"		TIME-PART	88	"			2
18		"		TIME-EVENING	88	"			3
19	LIVE ON CAMPUS?	"	16	ON-CAMPUS-CODE	03	"	21	1N	CODE
21		"		ON-CAMPUS	88	"			1
22				OFF-CAMPUS	88	"			2
23	EMPLOYED WHILE A STUDENT?	"	17	EMPLOYED-CODE	03	"	22	1N	CODE
24		"		EMPLOYED-NO	88	"			0
25		"		EMPLOYED-PART-TIME	88	"			1
26		"		EMPLOYED-FULL-TIME	88	"			2
27	PLANNED DEPARTMENT	"	18-20	DEPARTMENT-OF-STUDY	03	"	23	3A	

PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE
STUDENT	1	ADMISSIONS	1	APPLICATION

CONTROL FIELDS: A (7 ALPHA-NUM) — B (10 PACKED DECIMAL) SOCIAL-SECURITY-NO

NAME OF ANALYST: KAISER — DATE MO DAY YR: 10/4/76 — PAGE 9 OF 13

FILE CONVERSION SOURCE: CARD [X] TAPE [ ] — RECORD LENGTH: — BLOCK: :1 — FILE IDENTIFICATION: — HEADER LABEL FORMAT:

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME / 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1	PLANNED MAJOR	030	21-27	PLANNED-MAJOR	03	030	26	7A	
2	EDUCATION COMBINATION	"	28	EDUCATION-COMB	03	"	33	1N	CODE
3		"		ED-COMB-NO	88	"			0
4		"		ED-COMB-YES	88	"			1
5	CAREER INTEREST	"	29-42	CAREER-INT	03	"	34	14A	
6	PREVIOUS APPLICATION DATE	"	43-45	PREV-APPL-DATE	03	"	-	-	
7	SEMESTER IN APPL DATE	"	43	PREV-APPL-SEM	05	"	48	1N	CODE
8		"		PREV-APPL-FALL	88	"			1
9		"		PREV-APPL-SPRING	88	"			2
10		"		PREV-APPL-SUMMER	88	"			3
11		"		PREV-APPL-SPEC	88	"			4
12	YEAR IN APPL DATE	"	44-45	PREV-APPL-YEAR	05	"	49	2N	
13	SOURCE OF INFO ABOUT US	"	46-53	SOURCE-OF-INFO	03	"	51	8A	
14	TEST CODE 1	"	54	TEST-1	03	"	59	1N	CODE
15		"		TEST-SAT	88	"			1
16		"		TEST-REGENTS	88	"			2
17		"		TEST-GRE	88	"			3
18		"		TEST-GMAT	88	"			4
19		"		TEST-NAT-SCHOL	88	"			5
21									
22									
23	TEST CODE 2	"	59	TEST-2	03	"	64	1N	CODE
24	TEST CODE 3	"	64	TEST-3	03	"	69	1N	CODE
25	TEST CODE 4	"	69	TEST-4	03	"	74	1N	CODE
26	TEST DATE 1	"	55-58	TEST-1-DATE	03	"	-	-	
27	MONTH IN TEST DATE 1	"	55-56	TEST-1-DATE-MONTH	05	"	60	2N	

PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE
STUDENT	1	ADMISSIONS	1	APPLICATION

CONTROL FIELDS: A (7 ALPHA-NUM.) B (10 PACKED DECIMAL) SOCIAL-SECURITY-NO

NAME OF ANALYST: KAISER — DATE (MO DAY YR): 10/4/76 — PAGE 10 OF 13

FILE CONVERSION SOURCE: CARD [X] TAPE [ ] — RECORD LENGTH: — BLOCK: :1 — FILE IDENTIFICATION: — HEADER LABEL FORMAT:

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1	YEAR IN TEST DATE 1	030	57-58	TEST-1-DATE-YR	05	030	62	2N	
2	TEST DATE 2	"	60-63	TEST-2-DATE	03	"	-	-	
3	MONTH IN TEST DATE 2	"	60-61	TEST-2-DATE-MONTH	05	"	65	2N	
4	YEAR IN TEST DATE 2	"	62-63	TEST-2-DATE-YR	05	"	67	2N	
5	TEST DATE 3	"	65-68	TEST-3-DATE	03	"	-	-	
6	MONTH IN TEST DATE 3	"	65-66	TEST-3-DATE-MO	05	"	70	2N	
7	YEAR IN TEST DATE 3	"	67-68	TEST-3-DATE-YR	05	"	72	2N	
8	TEST DATE 4	"	70-73	TEST-4-DATE	03	"	-	-	
9	MONTH IN TEST DATE 4	"	70-71	TEST-4-DATE-MO	05	"	75	2N	
10	YEAR IN TEST DATE 4	"	72-73	TEST-4-DATE-YR	05	"	77	2N	
11									
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PRINT OR TYPE ALL INFORMATION

DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE
STUDENT	1	ADMISSIONS	1	APPLICATION

CONTROL FIELDS: A (7 ALPHA-NUM) B (10 PACKED DECIMAL) SOCIAL_SECURITY_NO

NAME OF ANALYST: KAISER | DATE (MO DAY YR): 10/4/76 | PAGE 11 OF 13

FILE CONVERSION SOURCE: CARD [X] TAPE [ ]

RECORD LENGTH | BLOCK :1 | FILE IDENTIFICATION | HEADER LABEL FORMAT

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1		032		APP_SCHOOLS_ATTEND_REC	01				
2	SOCIAL SECURITY NUMBER	032	4-12	SOCIAL_SECURITY_NO	03	032	11	9P	
3	SEQUENCE NUMBER OF SCHOOLS	"	13	SEQ_NUMBER	03	"	18	1N	
4	DATE BEGAN AT SCHOOL	"	14-17	DATE_BEGAN	03	"	-	-	
5	MONTH IN DATE BEGAN	"	14-15	DATE_BEGAN_MO	05	"	19	2N	
6	YEAR IN DATE BEGAN	"	16-17	DATE_BEGAN_YR	05	"	21	2N	
7	DATE LEFT SCHOOL	"	18-21	DATE_LEFT	03	"	-	-	
8	MONTH IN DATE LEFT	"	18-19	DATE_LEFT_MO	05	"	23	2N	
9	YEAR IN DATE LEFT	"	20-21	DATE_LEFT_YR	05	"	25	2N	
10	LEVEL OF SCHOOL	"	22	SCHOOL-LEVEL	03	"	27	1N	CODE
11		"		LEVEL-IS-HIGH-SCHOOL	88	"			1
12		"		LEVEL-IS-PREP-SCHOOL	88	"			2
13		"		LEVEL-IS-COLLEGE	88	"			3
14		"		LEVEL-IS-TECH-SCHOOL	88	"			4
15									
16	SCHOOL CODE	"	23-26	SCHOOL-CODE	03	"	28	4N	
17	SCHOOL NAME	"	27-53	SCHOOL-NAME	03	"	32	27A	
18	SCHOOL ADDRESS	"	54-75	SCHOOL-ADDRESS	03	"	59	22A	
19									
21									
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DATA USEAGE FORM

SYSTEM STUDENT	CODE 1	SUBSYSTEM ADMISSIONS	CODE 1
DATA SOURCE APPLICATION			
CONTROL FIELDS A (7 ALPHA-NUM.)	B (10 PACKED DECIMAL) SOCIAL-SECURITY-NO	NAME OF ANALYST KAISER	DATE MO DAY YR 10/4/76	PAGE 13 OF 13
FILE CONVERSION SOURCE: CARD [X] TAPE [ ]	RECORD LENGTH	BLOCK :1	FILE IDENTIFICATION	HEADER LABEL FORMAT

	INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1		036		APP-ALUMNI-RELATION-REC	01				
2	SOCIAL SECURITY NUMBER	036	4-12	SOCIAL-SECURITY-NO	03	036	11	9P	
3	FIRST INITIAL OF ALUMNI	"	13	FIRST-INITIAL	03	"	18	1A	
4	MIDDLE INITIAL	"	14	MIDDLE-INITIAL	03	"	19	1A	
5	LAST NAME OF ALUMNI	"	15-29	LAST-NAME	03	"	20	15A	
6	ALUMNI JR SR CODE	"	30	JR-SR-CODE	03	"	35	1N	CODE
7		"		CODE-IS-SR	88	"			1
8		"		CODE-IS-JR	88	"			2
9		"		CODE-IS-THE-THIRD	88	"			3
10		"		CODE-IS-THE-FOURTH	88	"			4
11	ALUMNI PRESENT ADDRESS	"	31-52	ALUMNI-ADDRESS	03	"	36	22A	
12	ALUMNI PRESENT CITY	"	53-65	ALUMNI-CITY	03	"	58	13A	
13	ALUMNI STATE	"	66-67	STATE	03	"	71	2A	
14	ZIP CODE	"	68-72	ZIP-CODE	03	"	73	5N	
15	RELATIONSHIP CODE	"	73	RELATION-CODE	03	"	78	1N	CODE
16		"		RELATION-IS-PARENT	88	"			1
17		"		RELATION-IS-FILIAL	88	"			2
18		"		RELATION-IS-GUARDIAN	88	"			3
19		"		RELATION-IS-COUSIN	88	"			4
21		"		RELATION-IS-OTHER	88	"			5
22	ALUMNI GRADUATION YEAR	"	74-75	ALUM-GRAD-YEAR	03	"	79	2N	
23									
24									
25									
26									
27									

PRINT OR TYPE ALL INFORMATION

SAMPLE REPORTS

The following pages contain samples of reports that may be prepared from the data carried in the Z-file for an educational information system as illustrated in the preceeding high-level flow charts. It should be clear that these sample reports illustrate only a small number of the reports that such a system may require. The reports that are shown should be adequate to provide an understanding of the flexibility of the overall system.

Data from the input records would be controlled by the Data-name dictionary in the development of reports. The Data-name dictionary is set-up from record descriptor parameters that are shown on the Data Useage Form. In this way great flexibility can be provided for the development of reports.

The following reports are shown:

<u>Application Status</u> This report provides data relating to each application during a particular admissions period. It is in alphabetic sequence within major school or department. It shows the status of each application and details relating to each applicant.

<u>Counselling Record</u> The Counselling Record is to be made available only to a student's counsellor. It contains data relating to the background and current performance of the student. It also shows the future plans of the student in terms of intended course work and projects.

Recruiting Report - School Data
This report permits the analysis of a recruiting effort to be made in terms of how many students are attracted from each school in a given area. It shows when a school is visited by a recruiter and how many persons apply and are accepted (and actually register). Such a report may encourage improvements to be made in the recruiting effort.

Recruiting Expense Analysis This report is designed to facilitate the evaluation of recruiting results versus expense that is related to the recruiting effort. In this sample report data is shown for each recruiter for the several trips that are made each year for recruiting purposes.

Course Demand Analysis Student demand for certain courses at certain times is evaluated on this report. Such a report might permit a department to predict teaching and classroom resource requirements earlier and with more certainty.

```
                                          INTERCOLLEGIATE SYSTEMS            APRIL 20, 1976        PAGE  1
                                          JOHNSONVILLE COL EG

                                         APPLICATION STATUS REPORT

                                        DESIRE M  #         V       DESIRED SAT REG   HIGH-SCHOOL-NAME     CITY          STATE
LAST NAME        FIRST NAME     MI  STATUS  ENTRY  F YR D M F A VIS  PROGRAM       AVG   STAND.  COUNSEL OR-NAME PHONE #

AD MS            RALPH           D   APP  FR SEP 76 M 18 1 0 N       BUS AD 1 20 1210  PEARL RIVER           PEARL RIVE
      22  LEVITAN PLACE                    12 -467820                                3.8   12 /135  M. ALV REZ     407-                2
      PEARL RIVER       NY  19704          APPL.01/20/76  REC.04/15/76

ADKINSON         SUSAN           L   ADM  TF SEP 76 F 19 1 0 N N     SOCIOL 1250 1 90  BRONXVILLE            BRONXVILLE
      14 PEYTON PLACE                      12 -2746821                               2.9   420/60   R. PETERSON    274-1
      BRONXVILLE        NY  192            AP L.01/10/76 REC.02/ 5/76 DEC.03/15/76 PREV.03/20/75
                                                                                     COLLEGE: WESTCHESTER COM .     WHITE PLAINS

AGMARA           DEBORAH         M   ADM  FR JUL 76 F 20 1 Y   N F1  BIOL   1020        ST. THOMAS AC DEMY  MENGUBAJ                1
      761 POST BOX A                                                                 3.2   120/125  P. KRAUSE
      MENGUBAJA             6104           AP L.12/10/75 REC.01/15/76
   ***NIGERIA


                        SORT SEQUENCE:                                              SUMMARY INFORMATION:
                           1. STUDENT SHORT NAME                                      TOTAL STUDENTS APPLYING BY
                           2. SOCIAL SECURITY NUMBER                                  TOTAL ADMITTED . . .      AVER
                                                                                      TOTAL APPLICATIONS PENDING
                                                                                      TOTAL DENIED
                                                                                      TOTAL FOREIGN
                                                                                      TOTALS BY ETHNIC/MINORITY GROUP
                                                                                            BY DIVISION OR MAJOR
                        DATA SOURCE:
                           APPLICATION RECORDS
                           DECISION RECORD
```

STUDENT COUNSELLING RECORD

LOCAL:	142 NORTHEAST DORMITORY	7-4627	NAME:	PETER J.	ALVAREZ
MAIL:	BOX 1649 CAMPUS		ADVISOR:	J SWENSON	1979
PERM:	821 SOUTH CIRCLE BALDERDASH, MD 22907		STU-ADV: AGE: BIRTH:	S MURPHY 19 12/12/57	BIOLOGY
CONT:	MR. JOHN P ALVAREZ PERM ADDRESS	FATHER 472-1440	GRAD:	BALDERDASH HIGH 1974	
MINOR:	SPANISH SURNAME		AVG:	MS. DONALDSON 472-6647 87 SAT: 1120	
WORK:	2YR SUMMER CAMP COUNSEL		LANG:	SPANISH PORTUGESE	
CAREER:	UNDECIDED		WORK:	20 HRS WK WORKSTUDY-PM	

FALL 75				SPRING 76			
ENG 201	3	B	JACKSON	ENG 202	3	B	JOHNSTONE
SPAN 430	3	A	LEIDA	RUSS 101	3	C	ZAGORSKI
SCI 100L	3	A	STEVENS	SCI 101P	4	B	STEVENS
MATH 120	4	C	JONES	MATH 130	3	B	KANT
PHIL 160	3	C	PETERSON	PHIL 210	3	A	BROWN
PHYS ED.	1	B		PHYS ED.	1	B	
	17	3.0			17	3.0	

FALL 76		SPRING 77		FALL 77		SPRING 78		SUMMER 78	
BIOL 210F	4	BIOL 250	4	BIOL 319	3	BIOL 640P	2	BIOL 700S	4
ENGL 240	3	BUS 110	3	ACCT 120	3	BUS 210	3		
CHEM 120	4	CHEM 130	4	CHEM 140	4	BIOL 414	3		
MATH 260	3	MATH 280	3	BIOL 328	4				
PAL 320	3	ARCH 323	3	BUS 222	3				

TO FALL 76: 34 CR GPA 3.0

PROJECT: PLANNED STUDY OF MOLLUSK TUSKS IN SWITZERLAND SUMMER 78

RESEARCH PAPER: ON SWISS MIST AND SWISS MISSES

ACTIVITIES: KAPPA CUPPA TEA - V.P. FROSH SOCCER ROWING 1

PETER J ALVAREZ

INTERCOLLEGIATE SYSTEM
JOHNSONVILLE COLLEGE

RECRUITING REPORT - SCHOOL DATA

CODE		SCHOOL	CITY	CAT	DATE	*---------- THIS YEAR INT	APP	%	ADM	%	REG	%------------*	TIMES VISITED	*-----------	--LAST YEAR-- INT	APP	%	ADM	%	REG	%----*
6734	NY	ST JOSEPH	ALBANY	H	10/22/75	40	30	75	10	33	10	100	8	YES	32	8	25	6	75	6	10
5472	NY	COLONIE	COLONIE	H	10/15/75	60	42	70	16	39	8	50	3	NO		50		25	50	15	60
5782	NY	BETHLEHEM	DELMAR	H	11/20/75	28	14	50	7	50	7	100	6	YES	20	15	75	10	6	5	50
6624	NY	PETERSON	DEWITT	H	10/12/75	20	5	25	4	80	3	75	5	NO		10		5	50	3	60
					TOTALS	640	160	25%	80	50%	60	75%	***		550	110	20%	60	50	45	70

INTERCOLLEGIATE SYSTEMS
JOHNSONVILLE COLLEGE

JULY 20,1976

RECRUITING EXPENSE ANALYSIS - 1975

RECRUITER NAME	DATE	SCHOOL	CITY	ST	CAT	CODE	INT	APPL	%	ADM	%	REG	%	COST	TOTAL	COST/ APPL.
ADAMSON R J																
	NOV 16	ST JOSEPH	ALBANY	NY	H	4571	40	20	50%	15	75%	10	67%			
	NOV 16	ALBANY HIGH	ALBANY	NY	H	9252	60	40	67%	25	63%	20	80%			
	NOV 17	DUANE	ALBANY	NY	H	2474	10	8	80%	6	75%	3	50%			
	NOV 17	COLONIE	COLONIE	NY	H	3826	50	40	80%	35	87%	9	26%			
	NOV 18	BETHLEHEM	DELMAR	NY	H	2324	20	15	75%	10	67%	5	50%			
							180	123	68%	91	74%	47	52%	62.00		
	NOV 24	ITHACA	ITHACA	NY	H	7401	30	15	50%	10	67%	9	90%			
	NOV 25	CORNING	CORNING	NY	H	5619	42	30	71%	20	67%	15	75%			
							72	45	63%	30	67%	24	80%	85.50		
						TOTAL	252	178	71%	121	68%	71	59%		147.50	1.20

INTERCOLLEGIATE SYSTEMS
JOHNSONVILLE COLLEGE

APRIL 10, 1976

COURSE DEMAND ANALYSIS

DEPT.	COURSE # TITLE	PERIOD	TIME	SPRING 1976 REG	DR	NET	TREND	FALL 1976 WANT	F	CONF	SPRING 1977 WANT	F	CONF	FALL 197[illegible] WANT	F	CONF	SPRING 197[illegible] WANT	F	CONF
BIOLOGY	BIO 124 INTRO TO BIOLOGY	M-W-F	A M	75	10	65	-2%	60	70	.8	75	85	.7	40	58	.7	2[illegible]	72	.6
		T-TH	EVE	25	2	23	+4%	20	24	.9	27	29	.8	15	25	.7	10	2[illegible]	.5
		W-F	P M	39	14	25	+4%	40	36	.6	16	25	.7	10	30	.5	12	30	.4
		TOTALS		139*	26	113			130*			139*			1[illegible]3*			12[illegible]	

TOTALS AND STATISTICS:
F - TOTALS BY COURSE & DEPT.
DR TOTALS BY COURSE & DEPT.
% OF DROPS BY COURSE & DEPT.

DATA SORT SEQUENCE:
1. DEPARTMENT CODE
2. COURSE NO.
3. DATE
4. TIME/PERIOD

INPUT RECORDS:
COURSE DESCRIPTION RECORDS
COURSE PLANS (PRE-REGISTRATION)
COURSE CHANGE RECORDS

F = PROBABLE TO AL REGIST[illegible]
ADJUSTING DEMAND COU[illegible]
HISTORICAL MULTIPLIER [illegible]
AND BY THE CONFIDENCE FACTOR.

Z-FILE SYSTEM - TECHNICAL NARRATIVE

The Z-File System is a generalized data base management information system for colleges and universities that is designed as a less complex approach for the users of control information. The system is built around a comprehensive and flexible data file that contains all the information in the system. The system is designed to function in institutions having between 1,000 and 3,000 students. While conceptually the Z-File System would apply to a larger user, time limitations in system design require limiting the scope to the present design model.

File Design

An attempt has been made to capture on the Z-File all pertinent data in the manual, or natural, system of the organization. Two basic design concepts have dominated the file design and system design:

1. The system should be designed to serve human beings and to support human values. It should protect the privacy of individuals. It should be flexible enough to be readily changed.

2. A determined effort should be made to reduce the complexity of the system in order to make it more understandable to the people who must use it and who are effected by it.

Logical data records on the Z-File have been kept as short as feasible in order to provide a basic unit of data that is less complex than the normal (long-record) file design. A fixed-length data record of 80 characters is used for the Z-File. In each record there is a 17 character control field, and a 63 character variable data area that is divided into fields that are directly related to the input media and the natural system. Related data fields that extend beyond the limits of a given data record are continued on another data record that is related to the first by control codes.

The control field of the data record contains codes that identify each record in the system. They provide for a logical data organization and retrieval method, and permit a complete audit-trial for all data that flows through the system. The Z-File contains data records that are direct images of the input-transaction data records. All original detail remains on the Z-File until it becomes obsolete and is purged or placed in less-active storage. Summarization of data takes place at later stages. It is this retention of detail data on the Z-File that provides much of the flexibility of the system. The Z-File is not "updated" in the traditional sense. Data fields within file records are not modified or changed except to replace erroneous data. New data is added to the file by direct transfer of transaction input data records onto the end of the Z-File. This causes the actual data organization of the Z-File to be based on transaction date.

Since the system/transaction-code field in the control section of each data record permits three bytes (or 6 decimals), the theoretical maximum number of different types of data records on the Z-File is 35^3 using an alpha-numeric code. In practice, the code schema is restricted by the use of the transaction code to provide some measure of controlled file organization. It is sufficient to say with great certainty that adequate flexibility is provided to store any type of data that may be found in institutions in or near the design size. The system design objective is not limited by its technical capability, but rather by the need by institutions for a system that lies between simple but inadequate systems and very complex "packaged" systems which may be powerful but are difficult to customize. Since most of the system packages that are available to institutions today are exceedingly complex, the modern management methods that they support are technically beyond the reach of most of the smaller institutions of higher education, unless they can accept the restraints of a packaged system.

The logical organization of the Z-File is controlled by the Data-Name Dictionary. This file of data definitions and data locations is the basic control for information retrieval from the Z-File. A more detailed description of the Data-Name Dictionary will be found on page .

The Z-File may be "updated" only by appending records at the end of the file (except for error corrections and the purging of old data). Essentially, the data on the file is in a dis-aggregated state. Since data is not summarized, it is always available for reports at the most detailed level possible. Reports that require data in summarized form must perform summarization at the time the relevant report(s) are printed. While this storage of detail may require more space in the Z-File, the use of short specialized data records avoids much of the wasted "filler" space that characterizes long data records. Also, the Z-File design cannot become obsolete as system changes add new types of data. New data records may always be added without affecting existing records. The data fields within each record are carried on the Z-File in an undefined form. Data that is required for reports may be read from the Z-File by accessing the appropriate data records and then by defining the particular data fields during the further processing of the data record. In most cases this detail data field definition will occur during the report printing run.

In effect, this reduces the complexity of the Z-File update program to that of a simple merge program. However, the overall system design contemplates that report data will be extracted during the update run, thereby requiring the selection of previously prepared data extraction modules.

The Shadow System

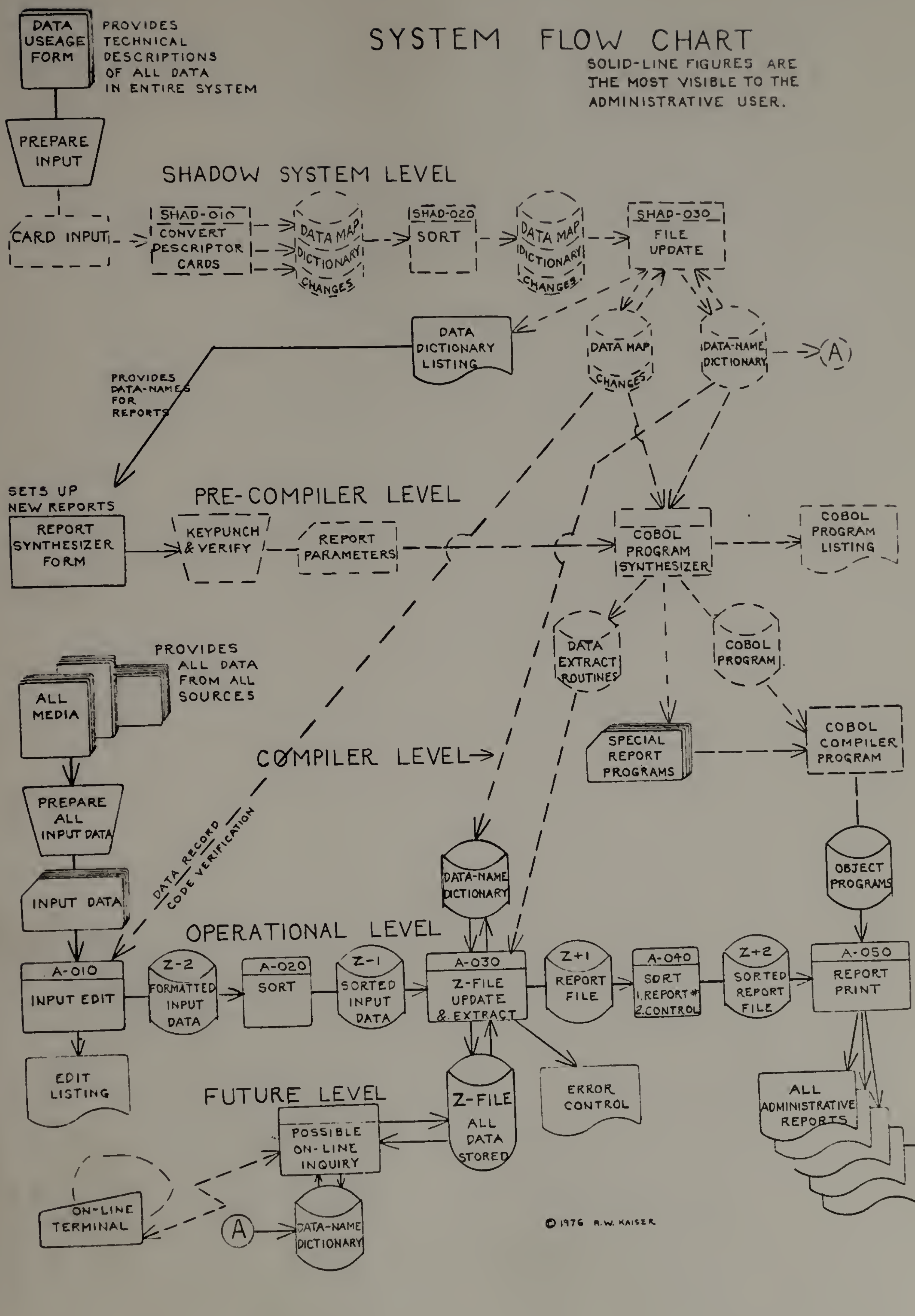
Since data is carried through the Z-File system in a form that is undefined at the detail (field) level on a record, a method must be provided to define all data at the appropriate level wherever needed. The Shadow System performs this function. The Shadow System is a separate series of computer programs and data files that stands behind and controls the Z-File System. The Z-File System is the operating-level of the system (fully visible to all users), where detailed transactions are stored and where all user reports are prepared. The Shadow System is a subtle but powerful data control system that is nearly transparent to users of the Z-File System. Since the entire system is to be essentially programmed in the ANS-COBOL language, the shadow system functions as the "Data Division" for each and every program and data record in the Z-File system. (See illustration on the following page.)

At all points in the operating Z-File system where the specific definition of data fields is required, the Shadow System performs that function via its two control files: the Data-Name Dictionary and the Data Map. The Data-Name Dictionary is a file of individual field definitions for each unique data-name within a given major system, and data record type. (The Z-File system is presently limited to 35 systems.) A major system may be the "student admissions systems". The Data-Name Dictionary also provides keys to data location in records on the Z-File, in effect providing extensive "file inversion" capabilities... should the necessity arise to scan the Z-File rapidly for data in a time-share mode.

The Data Map provides definition of all data on a particular data record. Further detail regarding these shadow system control files is on page 216.

Data records on the Z-File are defined and controlled by the shadow system in the following manner. The Data Usage Form is a "descriptor" form that is completed by the programmer or system designer in order to record the source and use of each piece of data in every data record that is carried in the Z-File system. On this descriptor form is recorded all pertinent information about a given data field (such as exact Data-name, field size, type, source field location and destination field location). See illustrations on the following pages.

SYSTEM FLOW CHART



DATA USEAGE FORM

SYSTEM	CODE	SUBSYSTEM	CODE	DATA SOURCE

CONTROL FIELDS A (7 ALPHA-NUM) B (10 PACKED DECIMAL)	NAME OF ANALYST	DATE MO. DAY YR. / /	PAGE OF

FILE CONVERSION SOURCE: CARD ☐ TAPE ☐	RECORD LENGTH	BLOCK	FILE IDENTIFICATION	HEADER LABEL FORMAT
		:1		

INPUT DATA DESCRIPTION	INPUT RECORD CODE	INPUT RECORD DATA POS.	01-OUTPUT RECORD-NAME 03- 05-OUTPUT DATA-NAME	LEVEL	OUTPUT DATA CODE	OUTPUT DATA FIELD	OUTPUT DATA SIZE	DECIMAL PICTURE OR REMARKS
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
21								
22								
23								
24								
25								
26								
27								

PRINT OR TYPE ALL INFORMATION

Information from the Data Usage Forms is keypunched or otherwise placed on machine-readable media and subsequently input to a conversion program which edits the information and places it on tape or disc. In this shadow system conversion run two records are output for each input line from the Data Usage Form. One output record is in the form of the Data-Name Dictionary. It contains all information about each detailed data field. The other output record contains information from the Data Usage Form that will be later used to identify <u>all</u> fields on a particular data record. This second record will be used to update the Data Map.

Record Layout Worksheet

ID: APPLICATION SHADOW SYSTEM DATA DESCRIPTOR Page 1 of 1 | Date 29 JAN. 77 BY R. W. KAISER

INPUT CARD LAYOUTS

ID: DESCRIPTOR TYPE 1 - NORMAL DATA FIELDS ←FOLD

RECORD CODE	PAGE LINE NO.	CARD TYPE	INPUT RECORD DATA POSITION FROM TO	DATA-NAME	COBOL LEVEL	OUTPUT REC CODE	OUT PUT POS.	FIELD SIZE (OUT)	INPUT DECIMAL PICTURE OR EDIT PARAMETERS		DATE CREATED (DUPPED) MO DAY YR
3X	3N	1	3N 3N	20X	2N	3X	7N	2N A	FIELD = D: PICTURE; N: CODE OR RANGE; 12X	CODE: UP TO 5 CHAR. SEPARATED BY COMMAS; RANGE: (MAX) -99 THRU 99 (NUMERIC)	

(ALL CODE FIELDS ARE ONE CHARACTER)

ID: DESCRIPTOR TYPE 3 - CODE MEANINGS (UP TO 43 FOR EACH INPUT CODE FIELD)

RECORD CODE	PAGE LINE NO.	CARD TYPE	INPUT FIELD POS.	"LITERAL" CODE MEANINGS	COBOL LEVEL	OUTPUT REC CODE		CODE PARAMETERS		DATE CREATED (DUPPED) MO DAY YR
3X	3N	3	3N (1 CHAR. ONLY)	(COBOL DATA NAME)	88 2N	2X		12X; FOR EACH MEANING: - UP TO 5 SINGLE CHAR. SEPARATED BY COMMAS. - RANGE (NUMERIC) UP TO "-99 THRU 99"	(POSSIBLE CODES: • ALPHABET EXCEPT I AND Ø • POSITIVE 0-9 • NEGATIVE 1-9)	

ID:

ID: DESCRIPTOR TYPE 7 - INPUT FORMAT CHANGE (CHANGED DATA SEQUENCE ON INPUT DATA RECORD)

		TYPE			DATE CREATED (DUPPED) MO DAY YR
2X		7	SAME FORMAT AS CARD TYPE 1 ABOVE (OUTPUT FIELDS REMAIN SAME)		

ID: DESCRIPTOR TYPE 9 - SECURITY PARAMETERS

RECORD CODE		TYPE	SPE			DATE CREATED (DUPPED) MO DAY YR
3X		9 N	N	SYSTEM SECURITY PARAMETERS OR ENCRYPTION ALGORITHM. 20A		

ID:

ID:

After all information from the Data Usage Forms has been processed through the conversion program and output on two transaction files, these transaction files must be sorted into the sequence of the two destination files (Data Map and Data-Name Dictionary). The sequence of the Data Map is: record code within system/sub-system code. The Data Map uses a variable-length record, since some Z-File transaction records have many small fields to be defined and others have only a few large fields. The Data-Name Dictionary File contains fixed-length records with "trailers" for transaction data locations on the Z-File (file inversion keys). The Data-Name Dictionary File is sorted and updated in the alpha-numeric sequence of the data-name within a given system/sub-system/record-code.

After sorting, the data-map and data-name dictionary descriptor data files are input to the Shadow System update program which prints an alphabetical control book (called the Data Dictionary) and updates the two files. A third type of record, that of a data record field-size or sequence-change is input at the same time and placed on the Data Map file. This data sequence-change record is described below.

The Data Map file is used to provide data definition for transaction records being fed into the Z-File system through the main Z-File transaction data conversion (input-edit) run. When a certain data record number is recognized by the Z-File edit run, the Data Map is accessed to check the validity of the particular transaction code for the transaction record. At this time, assuming a match is found on the transaction codes, the Data Map provides the Z-File input-edit program with the appropriate data record definitions to perform the edit function on incoming data and to convert that data to the format of the Z-File. In this manner, incoming data to the Z-File system is organized into the proper form so that the update of the Z-File may occur by direct transfer of the input transaction records. Thus the basically uncomplicated Shadow System controls and simplifies the handling of Z-File detail transaction data throughout the entire system - from input to report-printing.

The sequence change record mentioned above will allow data sequence changes without any programming effort. The change record on the Data Map simply causes the Z-File input transactions to be formatted in the edit run from the changed field sequence in the input card into the same Z-File out-put record as before. This may remove some of the present restrictions that now prevent needed changes from being made to media forms that are source documents for computerized systems.

The Data-Name Dictionary File is used by the Z-File system for several different purposes. Most importantly, it provides the data definition for operating-level report-print programs that use detail data records that are extracted from the Z-File. The printed alphabetic listing of the file shows the data-item format and COBOL "picture" of each data item in the system. This printed "Data Dictionary" may be used by a programmer when writing a program to print a report from data that has been extracted from the Z-File. Eventually the Data-Name Dictionary file may be used to automatically generate the Data Division (input file section) for such reports.

The Data-Name Dictionary File also may be used to provide data field location within given data records on the Z-File when the Z-File is accessed to provide time-share reports. In addition, as mentioned above, the file inversion trailer records in the Data-Name Dictionary File may be used to permit rapid random-access scanning of the Z-File. Related data fields in many different records on the Z-File may be thus retrieved via chain-linked addresses in the Data-Name Dictionary File record.

The COBOL Report Program Synthesizer sub-system (further described on page 224) also makes use of the Data-Name Dictionary File. First, the printed alphabetic listing (data dictionary) is used to identify available data items in the Z-File for use in filling out the report synthesizer form (page 230). Then, the Data-Name Dictionary File is used in the pre-compiler (COBOL synthesizer) program to synthesize the COBOL Data Division for a report.

The Z-File System

As described above, transaction data for the Z-File is input to the Z-File system through an edit program that obtains data-definition information from the Data Map file. In this edit program, transaction data is read from cards or other machine-sensitive media and re-formatted into data records that are ready for insertion into the Z-File. Appropriate testing of control fields in each record is performed by the edit programs. A printed listing is prepared of all input transactions. Batch totals are prepared as appropriate, and necessary counts are provided on input items in order to establish audit trails for all data in the Z-File system.

While theoretically there may be many different types of data records input at one time to the Z-File system, in practice, data will probably be submitted to the system in tightly controlled batches with certain pre-established control totals and/or media counts. Communication between the edit program and the Data Map will therefore not restrict the overall operational effectiveness of the edit run. (Details on the editing and processing of each type of data record are fetched from the Data Map.)

After the edited transaction data is placed in the Z-File format, it is output from the edit run onto tape or disc. Then it is sorted into the sequence of the Data-Name Dictionary File (transaction-code within system/sub-system code). It is then input to the Z-File update program.

The Z-File update program first processes the data on the existing Z-File through the program in order to create an output report file. On a given day, the operating system or a report-call record is used to set-up the update program to produce a series of records for scheduled reports. (Time-share reports are processed subsequently from the Z-File through dictionary-aided file scan.) The report call may also be input or added-to from the operator console. In any case, a report matrix is set-up in the Z-File update program which identifies each data record that contains data required for a given report. This report matrix causes one copy of each pertinent data record to be output to the report file for each report that uses a given record. If a certain record contains fields that are used on four reports that day, the report matrix causes four output records to be created from the one Z-File record (the Z-File record is not modified or erased).

At the same time the report matrix is set up in the update program, a series of report record generator subroutines is called-in from the program storage. These subroutines control the formatting of each output report data record that is extracted from the Z-File. There is one report record generator subroutine for each report to be printed that day (although some subroutines may share certain subroutine modules).

The report record generator subroutines take data records from the Z-File or, at the end, from the sorted transaction file, and truncates the 17 character control field from the record. This leaves the 63 character variable data portion of the Z-File record. To this 63 character portion is appended a report sequence section which consists of a single three-digit report number and four 5-character sort-control fields. The report record generator subroutine inserts the appropriate report number into the 3-digit report code field, and into the other four sort-control fields it inserts the appropriately programmed data from anywhere in the entire A-File record (including the 17 character control field). Data is inserted into the four fields in the proper position so that a single report-sort will sequence all report data records properly for all reports.

After the report data records are sorted into the proper sequence for the scheduled reports, the sorted report file is input to the report print programs. The report print programs summarize and prepare all data for the reports from the data on the report data records. The report programs are written in ANS-COBOL. When the data ends for a given report, the next report program is fetched from storage and that report is then printed. In this way all reports are continually printed until operator intervention is required for a forms change or until the report file is exhausted.

When transaction data is added to the Z-File a Data-Name Dictionary File record is also appended with the Z-File address of each important Data-Name. In this way a chain of linking addresses of data in the Z-File is developed on the Data-Name Dictionary File. This will permit efficient extraction of data from the Z-File for time-shared or one-time reports.

Periodic purging of the Z-File (and related Data-Name Dictionary) records will control the overall size of the files. Purged data will be retained in inactive storage (tape) for statistical or historical use.

<u>File Conversion</u>

The Shadow System handles all data format control for the Z-File system for both newly-developed applications and the conversion of existing data files to the Z-File format. The Data Usage Form is used to describe all data records and field formats for the Data Map and Data-Name Dictionary (which in turn control all data in the Z-File system). Information regarding file conversion is written in the third line at the top of the Data Usage Form.

PROGRAM DOCUMENTATION

The following pages contain program documentation for all the computer programs that make up the Z-File system. The system is interactive in that many programs affect or control other programs and all programs relate to the creation and maintenance of the Z-file data bank. The documentation of each program consists of the following forms or charts:

* high-level system flow chart showing the relation of all programs and files
* narrative of the program activities and basic functions
* detail block-diagram of the computer program, showing detailed program logic and all major program routines
* input and output data file layouts
* other technical data as required, including possible report samples and code tables.

The high level system flow-chart on the following page illustrates the relationship between the various programs. Following the system flow chart is the detail documentation for the following programs:

Operational Level - Input Edit

Operational Level - Main Z-file Update

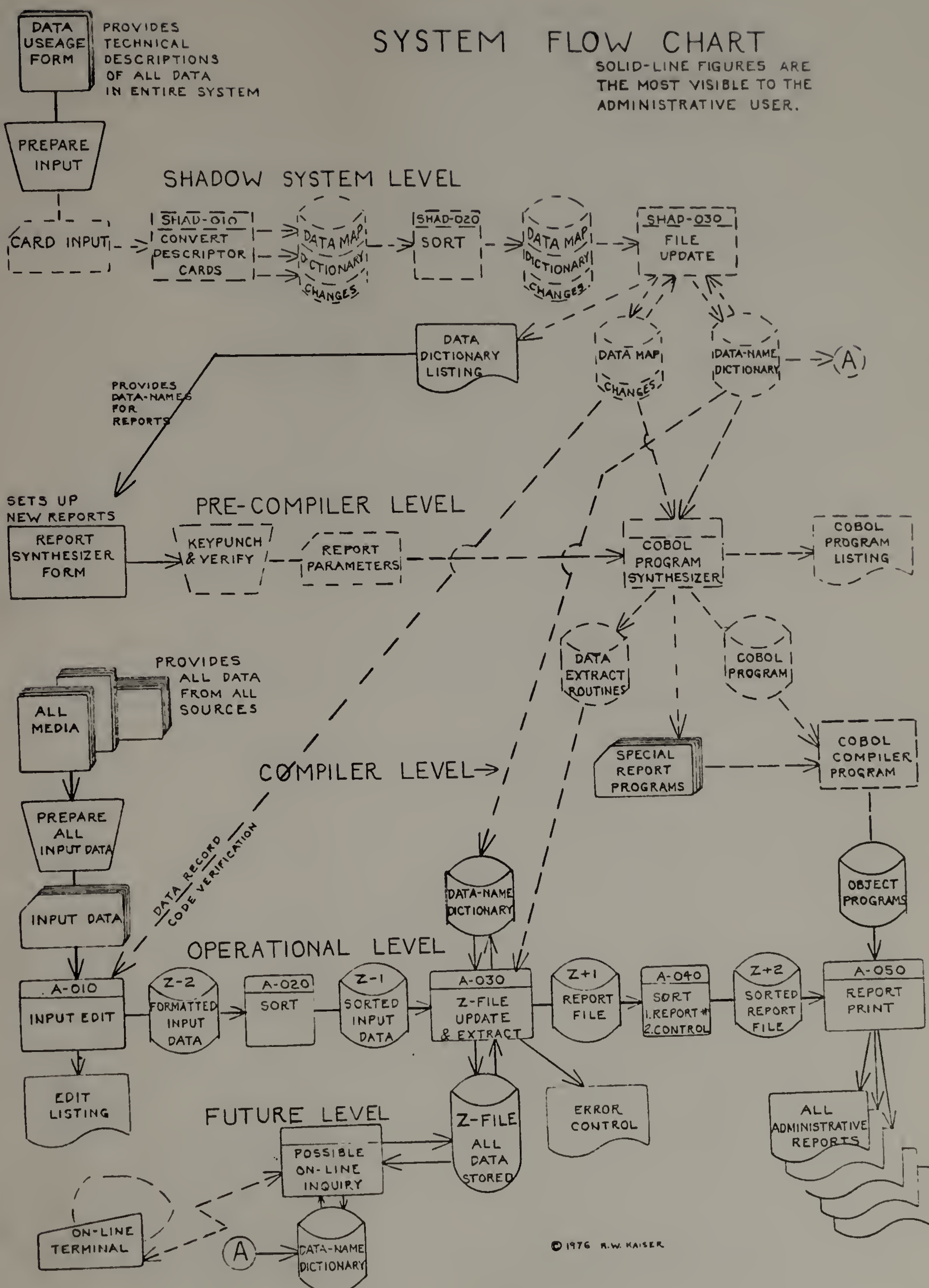
Shadow System - Data Descriptor Conversion (edit)

Shadow System - Data-Name Dictionary & Data Map Update Program

COBOL Program Synthesizer

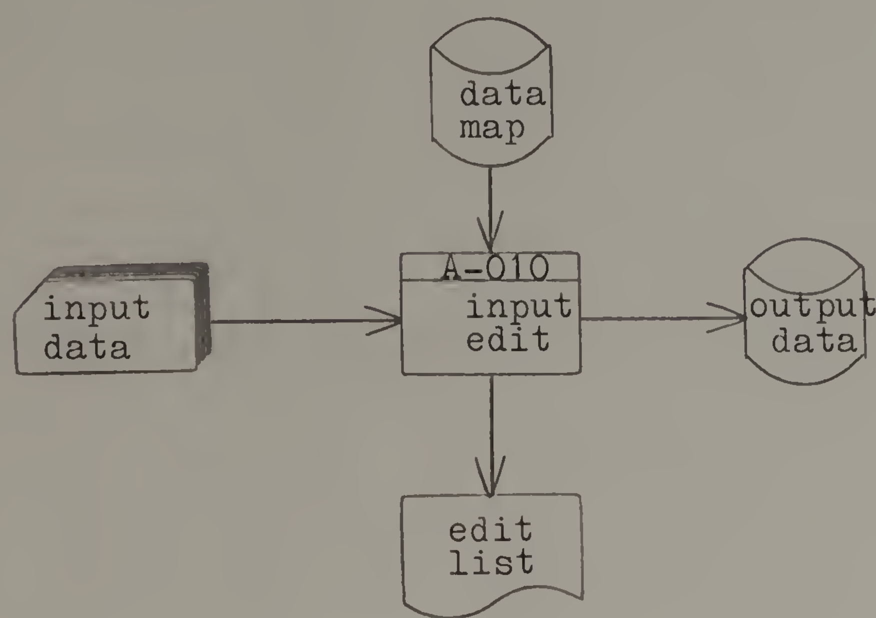
Individual report programs will be required to print all operational reports in the system. These report-print programs may be of a repetitave or one-time nature. In any case, they must be prepared to the specifications of the user of the reports. Whether these report programs are individually written or are prepared by the COBOL Program Synthesizer, the flexibility of the Z-file data organization and the existance of the Data-name Dictionary will aid in their preparation. The fact that the installation of the Z-file System at an educational institution requires special program writing mainly for report programs should substantially reduce both installation time and cost.

Following the COBOL Program Synthesizer documentation is a sample report-print program which illustrates both the main-update data extract routine and the actual COBOL program coding.


SYSTEM FLOW CHART
SOLID-LINE FIGURES ARE THE MOST VISIBLE TO THE ADMINISTRATIVE USER.
DATA USEAGE FORM
PROVIDES TECHNICAL DESCRIPTIONS OF ALL DATA IN ENTIRE SYSTEM
PREPARE INPUT
SHADOW SYSTEM LEVEL
CARD INPUT
SHAD-010 CONVERT DESCRIPTOR CARDS
DATA MAP DICTIONARY CHANGES
SHAD-020 SORT
DATA MAP DICTIONARY CHANGES
SHAD-030 FILE UPDATE
DATA DICTIONARY LISTING
DATA MAP CHANGES
DATA-NAME DICTIONARY
A
PROVIDES DATA-NAMES FOR REPORTS
SETS UP NEW REPORTS
PRE-COMPILER LEVEL
REPORT SYNTHESIZER FORM
KEYPUNCH & VERIFY
REPORT PARAMETERS
COBOL PROGRAM SYNTHESIZER
COBOL PROGRAM LISTING
DATA EXTRACT ROUTINES
COBOL PROGRAM
PROVIDES ALL DATA FROM ALL SOURCES
ALL MEDIA
SPECIAL REPORT PROGRAMS
COBOL COMPILER PROGRAM
COMPILER LEVEL→
PREPARE ALL INPUT DATA
DATA RECORD CODE VERIFICATION
OBJECT PROGRAMS
DATA-NAME DICTIONARY
INPUT DATA
OPERATIONAL LEVEL
A-010 INPUT EDIT
Z-2 FORMATTED INPUT DATA
A-020 SORT
Z-1 SORTED INPUT DATA
A-030 Z-FILE UPDATE & EXTRACT
Z+1 REPORT FILE
A-040 SORT 1.REPORT # 2.CONTROL
Z+2 SORTED REPORT FILE
A-050 REPORT PRINT
EDIT LISTING
FUTURE LEVEL
Z-FILE ALL DATA STORED
ERROR CONTROL
ALL ADMINISTRATIVE REPORTS
POSSIBLE ON-LINE INQUIRY
ON-LINE TERMINAL
A
DATA-NAME DICTIONARY

OPERATIONAL LEVEL - MAIN INPUT EDIT PROGRAM

This computer program is designed to accept all data that is destined to be placed on the Z-file data bank. The program edits (verifies) the input data, prints a control list, develops appropriate control codes, and converts the input data to output records in the format of the Z-file.



The program first requires that the lead input record is a table of active system codes that relate to the input data to be subsequently read into the system. A table is set up for this system code (the first character of the 3-character record code in each input record). This allows the data control section to further enforce the entry of valid data into the Z-file system. Each subsequent data record is checked against the system code table.

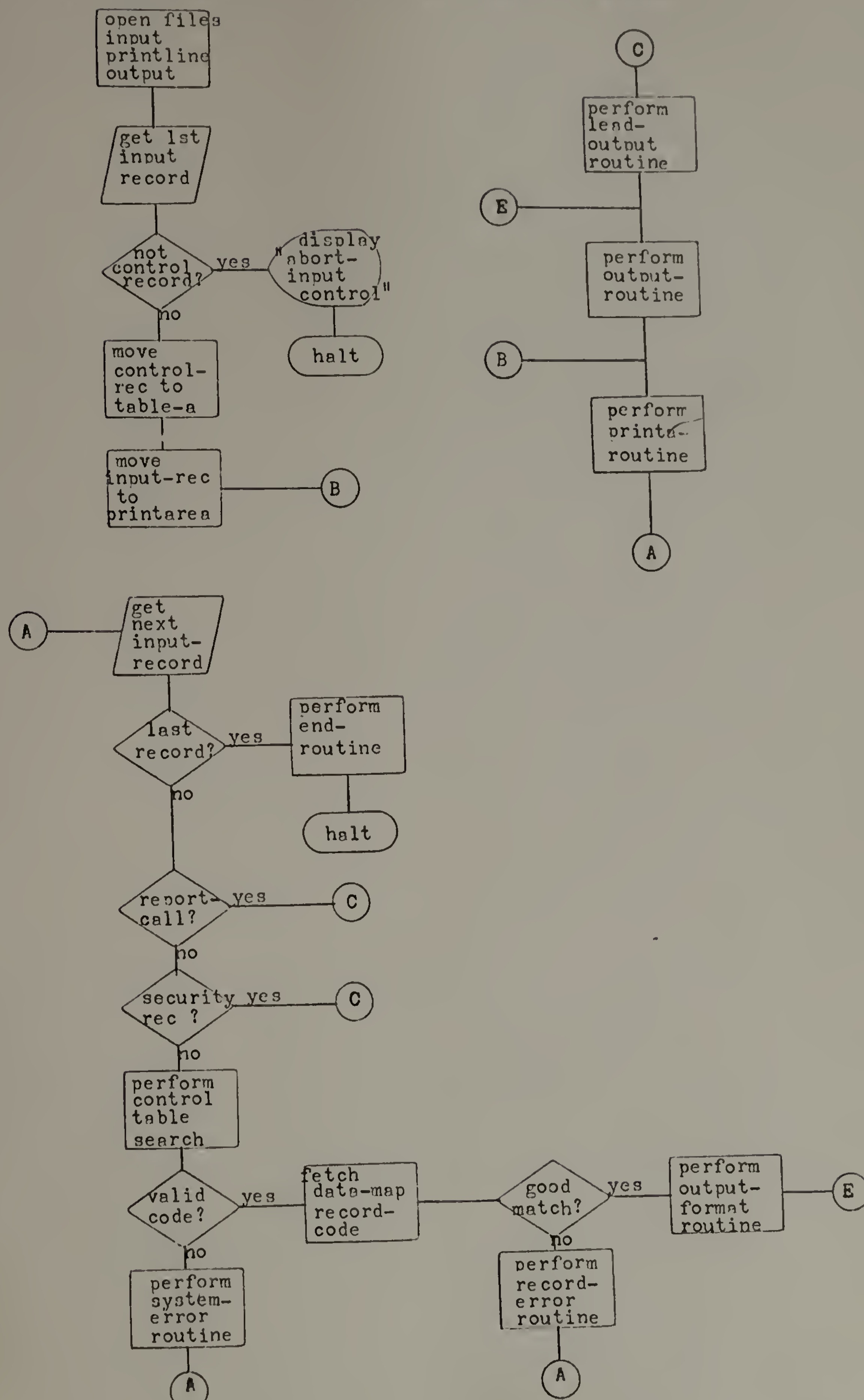
The next two input records may be related to report calls. These records either set up a new report by relating data records to a report, or call a series of report-printing programs that ultimately extract data from the Z-file and print that data on reports. In one case, the new report record contains the number of the new report and the record code characters for each of the many records that may go into the printing of a report. The 80 character input record format permits a maximum of 24 different records to be combined into a given printed report (this means 24 different types of records...each type of which may be represented by thousands of data records on the Z-file).

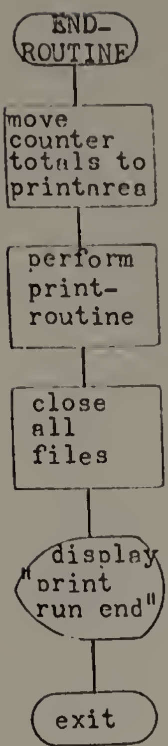
A third type of input record may be a security parameter record. While security control over all records is maintained through the Data-name dictionary, day-to-day changes may be made in security parameters (such as daily encryption codes) through this record. This provides the system with the capability for multiple levels of encryption. The security record is passed directly through the edit run to the Z-file update program.

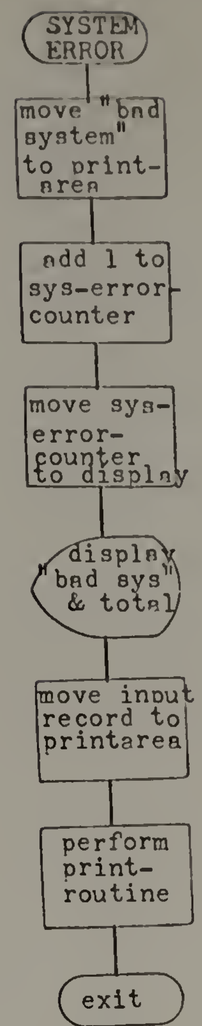
Other input data records are first tested against the system-code table and, if acceptable, cause the data-map control record to be checked for a valid record code. Using information provided either by the data-map or by appropriate edit sub-routines, each data record is then edited as necessary, printed on the edit listing, and formatted according to the needs of the Z-file data bank. It is intended that the record will not be modified after this computer edit program handles it. It will be stored in its exact form on the Z-file data bank.

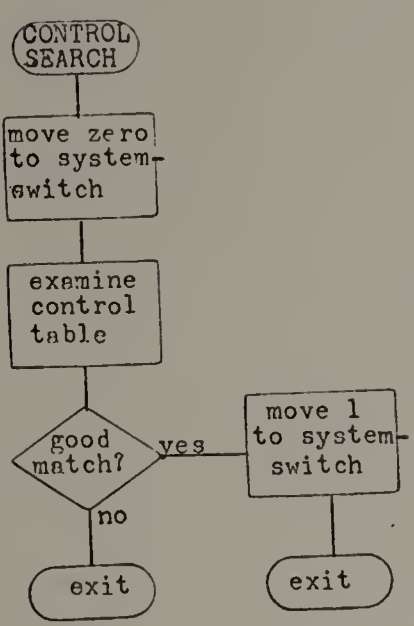
A series of sub-routines provide most of the detail analysis in the input edit program. Most of these sub-routines are quite standard (such as end-routine, error-flag and print-format routines). However, the Record-Format routine on the last page (4th) of the block diagram may require further explanation. A control-image of the output record has been called into memory. The input data record is compared with this record to validate the record code (in the first column of the diagram). If a hit is made on the record code, the control record supplies the necessary code field edit parameters as illustrated in the sample data in the secord column of the diagram. Assuming the data record contains correct codes (or other editable data), routine moves to the third column of the diagram, where the input data record is moved to the print area for the edit listing and reformatted into the appropriate output record to be placed on the Z-file.

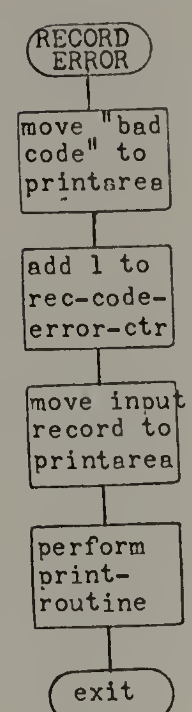
PROGRAM BLOCK DIAGRAM - MAIN INPUT EDIT PROGRAM

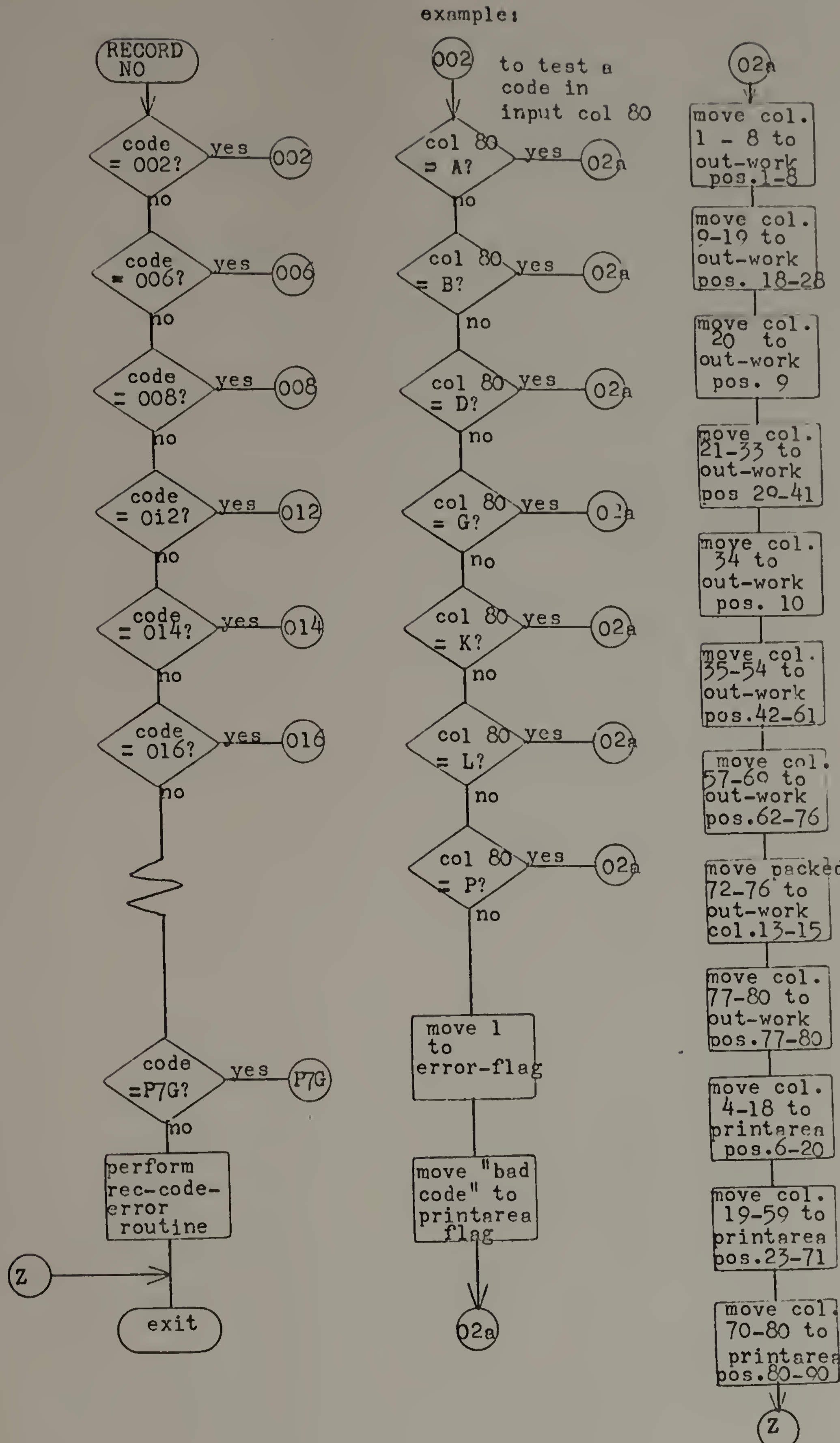


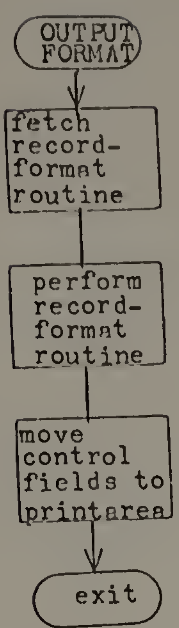

END-ROUTINE
move counter totals to printarea
perform print-routine
close all files
display "print run end"
exit

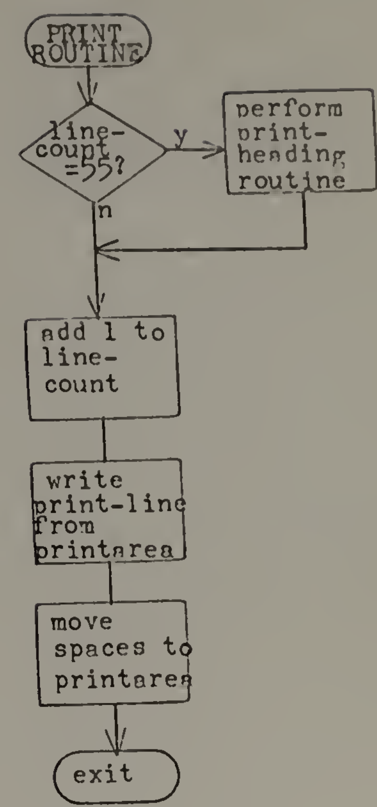

SYSTEM ERROR
move "bad system" to print-area
add 1 to sys-error-counter
move sys-error-counter to display
display "bad sys" & total
move input record to printarea
perform print-routine
exit

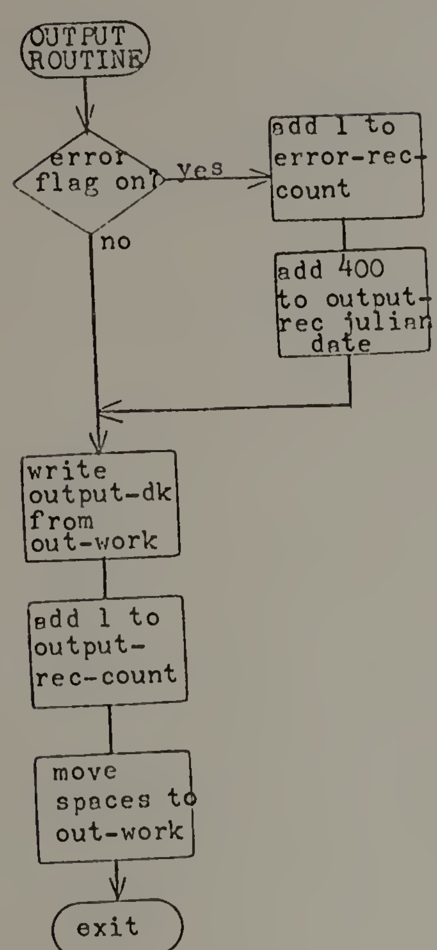

CONTROL SEARCH
move zero to system-switch
examine control table
good match?
yes
no
move 1 to system-switch
exit
exit

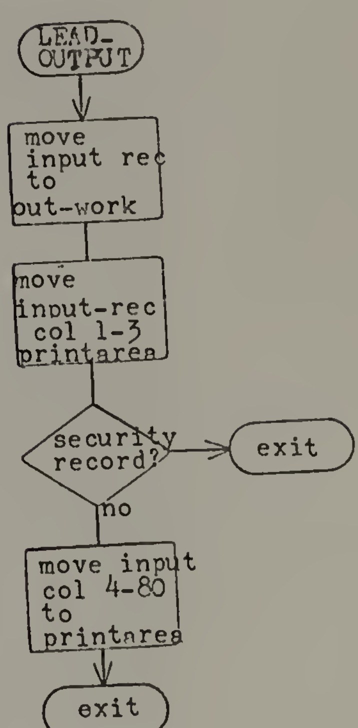

RECORD ERROR
move "bad code" to printarea
add 1 to rec-code-error-ctr
move input record to printarea
perform print-routine
exit


example:
RECORD NO
code = 002?
yes
002
no
code = 006?
006
code = 008?
008
code = 012?
012
code = 014?
014
code = 016?
016
code =P7G?
P7G
perform rec-code-error routine
Z
exit
002
to test a code in input col 80
col 80 = A?
02a
col 80 = B?
col 80 = D?
col 80 = G?
col 80 = K?
col 80 = L?
col 80 = P?
move 1 to error-flag
move "bad code" to printarea flag
02a
move col. 1 - 8 to out-work pos.1-8
move col. 9-19 to out-work pos. 18-28
move col. 20 to out-work pos. 9
move col. 21-33 to out-work pos 20-41
move col. 34 to out-work pos. 10
move col. 35-54 to out-work pos.42-61
move col. 57-69 to out-work pos.62-76
move packed 72-76 to out-work col.13-15
move col. 77-80 to out-work pos.77-80
move col. 4-18 to printarea pos.6-20
move col. 19-59 to printarea pos.23-71
move col. 70-80 to printarea pos.80-90
Z


OUTPUT FORMAT
fetch record-format routine
perform record-format routine
move control fields to printarea
exit


PRINT ROUTINE
line-count =55?
y
perform print-heading routine
n
add 1 to line-count
write print-line from printarea
move spaces to printarea
exit


OUTPUT ROUTINE
error flag on?
yes
add 1 to error-rec-count
add 400 to output-rec julian date
no
write output-dk from out-work
add 1 to output-rec-count
move spaces to out-work
exit


LEAD-OUTPUT
move input rec to out-work
move input-rec col 1-3 printarea
security record?
exit
no
move input col 4-80 to printarea
exit

INPUT DATA RECORD LAYOUTS

The following pages contain Record Layout Worksheet forms which document the data content of each and every input data record in the system. Such input data records must necessarily relate to a particular systems application or user. Therefore it can be anticipated that input data records will be unique to a given user or application. The data records shown are therefore samples that are selected to illustrate the various features of the system.

In the sample records shown, data has been taken from the sample Application for Admission and Interview Form shown in the previous section (page 142). It is anticipated that such data will be punched into cards. However it could be input from key-to-disc or any other appropriate equipment. The sample records on the following pages show the data as it would be organized on 80-column cards. All input data in the system should be so illustrated.

The input edit listing is a direct mirror image of the input card. It is kept in the sequence and image of the input data in order to provide a logical audit-trail for all data input to the Z-file system. Error records are flagged on the input listing for corrective action. They are also flagged internally as errors (in the date field) and passed on to the Z-file system where they can be appropriately controlled.

The output records are illustrated in the Z-file update program, since they are identical to the Z-file format.

Record Layout Worksheet

APPLICATION STUDENT - ADMISSIONS · Page 1 of 3 | Date 9/20/76 BY R.W. KAISER

ID:

ID: M-002 ADMISSION-INQUIRIES (PHONE OR MAIL) ←FOLD

MEDIA CODE	LAST NAME	TITLE	GIVEN NAME	INITIAL	ADDRESS		CITY (POST OFFICE)	STATE	ZIP	OTHER NATION	PROG INT
202	15A	MR MS JR	14A	A	20A		13A	2A	5N	3A	

← X OVERPUNCH = INITIAL FIRST, THEN GIVEN NAME

ID:

ID: M-006 RECRUITING-INTERVIEWS ← X OVERPUNCH = INITIAL FIRST, THEN GIVEN NAME

MEDIA CODE	INTERVIEW	SCHOOL CODE	STUDENT LAST NAME	STUDENT GIVEN NAME	INIT	TITL	DATE OF BIRTH	MAIL ADDRESS	CITY (POST OFFICE)	STATE	ZIP	CODES: PROG INT	REP ID	EVAL
006	2N	4N	13A	9A	A	MR MS JR	MO, DAY, YR	18A	13A	2A	5N			

ID: M-008 RECRUITING - ADVISOR

MEDIA CODE			STUDENT LAST NAME	ADVISOR LAST NAME	FIRST INIT	MI	TITLE	POSITION	ADVISOR MAIL ADDRESS	ADVISOR CITY (POST OFF.)	STATE	ZIP
008	← DUPLICATED FROM M-006 RELATED →			15A			MS MR DR	DEAN REV.	18A	13A	2A	5N

ID: M-012 SCHOOL-NAME

MEDIA CODE	SCHOOL CODE	DIV. NO.	SCHOOL SHORT NAME		SCHOOL NAME	SCHOOL DIVISION NAME	CODES: SIZE	AFFIL	# PROG
012	4N	2N	7A		35A	25A			

ID: M-014 SCHOOL-ADDRESS

MEDIA CODE	SCHOOL CODE		SCHOOL ADDRESS (MAIL)	SCHOOL CITY	COUNTY	STATE	NATION	ZIP	AREA CODE	PHONE NO.
014	4N		22A	13A	8A	2A	3A	5N	3N	7N

ID: M-016 SCHOOL- FACULTY/ADMIN. ← X OVERPUNCH = INITIAL FIRST, THEN GIVEN NAME

MEDIA CODE	SCHOOL CODE	SEQ NO		TITLE	GIVEN NAME	INITIAL	LAST NAME	JR SR	POSITION NAME	PHONE NO.
016	4N	2N		A	TITLE: MS MR DR DEAN PRES. CHAN. SEN. REP. PROF. GOV. REV. HON. 14A	A	15A	N	24A	7N

Record Layout Worksheet

ID: APPLICATION STUDENT–ADMISSIONS Page 2 of 3 | Date 9/20/76 BY: R.W. KAISER

←FOLD

ID: M-020 APPLICATION-NAME

X = USE FIRST INITIAL & FULL MIDDLE NAME

MEDIA CODE	SOCIAL SECURITY NO.	STUDENT LAST NAME	T I T	STUDENT FIRST NAME	STUDENT MIDDLE NAME	JR III	STUDENT OTHER LAST NAME	DATE OF BIRTH	DESIRE ENTRY
			MS MR			SR		MO. DAY YR	SM. YR
020	9N	15A		14A	14A	N	13A	6N	

X OVERPUNCH = HYPHENATE LAST NAME

ID: M-022 PERMANENT RESIDENCE

MEDIA CODE	S.S. NO. (DUPPED)	STUDENT PERMANENT ADDRESS	CITY	COUNTY	STATE	NATION	ZIP	AREA CODE	TELEPHONE NO.
022	9N	22A	13A	8A	2A	3A	5N	3N	7N

ID: M-024 PRESENT MAIL ADDRESS (IF DIFFERENT FROM M-022)

MEDIA CODE	S.S. NO. (DUPPED)	STUDENT STREET ADDRESS	CITY	VALID UNTIL	STATE	NATION	ZIP	AREA CODE	TELEPHONE NO.
				MO. DAY YR					
024	9N	22A	13A		2A	3A	5N	3N	7N

ID: M-026 RELATION

X OVERPUNCH = INITIAL FIRST, THEN GIVEN NAME

CODE: 1 PARENT, 2. SPOUSE, 3 FILIAL, 4 GUARDIAN, 5. OTHER

MEDIA CODE	S.S. NO (DUPPED)	T I T	GIVEN NAME	INITIAL	LAST NAME	MAIL ADDRESS	CITY	STATE	ZIP	REL
		MS MR MRS								
026	9N		9A	A	13A	18A	13A	2A	5N	

ID: M-028 OTHER DATA

X = OFFICER

*DEPENDENTS

MEDIA CODE	SS. NO. (DUPPED)	CITIZEN OF:	VISA	VETERAN	DISCHARGE DATE	TYPE	RANK	MO. FULL EMP.	FULL TIME WORK EXPER (FIELD)	POSITION	MINORITY CODE	FATHER OCCUPATION	MOTHER OCCUPATION	SPOUSE OCCUPATION	*	FIN AID
			A		MO. DAY YR											
028	9N	3A					N	N	8A	6A		10A	10A	7A	N	2N

ID: M-030 TESTS & STATUS

MEDIA CODE	SS. NO. (DUPPED)	A	B	C	D	E	PLAN. DEPT.	PLANNED MAJOR	EDCOB	CAREER INTEREST	PREV. APPL.	SOURCE OF INFO ABOUT COL.	TEST	DATE	TEST	DATE	TEST	DATE	TEST	DATE
	CODE: A. EMPLOYED B. FULL/PART C. STATUS D. MATRIC E. TERM										SEM. YR.			MO YR		MO YR.		MO YR.		MO YR
030							3A	7A	N	14A	N N	8A								

ID: M-032 SCHOOLS ATTENDED

MEDIA CODE	S.S. NO (DUPPED)		FROM (DATE)	UNTIL (DATE)	L E V E L	SCHOOL CODE	SCHOOL NAME	SCHOOL ADDRESS
			MO. YR.	MO. YR.				
032	9N					4N	27A	22A

Record Layout Worksheet

ID: M-034 COUNSEL APPLICATION STUDENT - ADMISSIONS — Page 3 of 3 — Date 9/20/76 BY: R.W. KAISER

MEDIA CODE	S.S. No. (DUPPED)	SEQ	CITY	STATE	ZIP	AREA CODE	PHONE NO.	TEL	COUNSELLOR LAST NAME	GRADE AVERAGE		
034	9N		13A	2N	5N	3N	7N		15A	3A		

←FOLD

ID: M-036 ALUMNI-RELATION

MEDIA CODE	S.S. NO (DUPPED)	FIRST INIT	MI	LAST NAME	EX SR	PRESENT ADDRESS	PRESENT CITY	STATE	ZIP	RELATION	GRAD YR.	
036	9N			15A	III	22A	13A	2A	5N		2N	

ID:

ID: M-042 ADMISSION DATA MISSING

MEDIA CODE	Soc. Sec. No.	STUDENT LAST NAME	FIRST INIT	MI	TEST SCORE MISSING (NAME)	TRANSCRIPT MISSING (SCHOOL NAME)	OTHER MISSING MATERIAL (DESCRIBE)	TITLE (MS MR DR DEAN)	OUR PERSON TO CONTACT	PHONE EXT.
042	9N	15A			6A	10A	18A		12A	4N

ID: M-044 ADMISSION DECISION

PROG DENY DELAY FRESH TFR GRAD FIN AID OTHER SPEC

MEDIA CODE	S.S. NO.	STUDENT LAST NAME	FIRST INIT	MI	HIGH SCHOOL GRADE AVG.	MAJOR	CLASS STD. % TOP	BEST JR/SR COURSE	WORST JR/SR COURSES	SEX		TOTAL COLLEGE CREDITS	CREDITS ACC.	G.P.A.	DEGREE HELD (HIGHEST)	SAT VERBAL	SAT QUANT	TEST	SCORE	TEST	SCORE	STATUS CODE	ADMIT PERIOD SEM YR
044	9N	15A			4N	2A	2N	3A	3A	[illegible]		3N	3N	3N	3A	3N	3N	N	4N		4N	2N	3N

ID: M-046 CONFIRMATION

MEDIA CODE	Soc. Sec. No	STUDENT LAST NAME	FIRST INIT	MI	PROG.	CAMPUS HOUSING BLDG. ROOM	STATUS CODE	ENTER PERIOD SEM YR.	TITLE (MS MR DR DEAN)	ADVISOR FIRST NAME	ADVISOR LAST NAME	
046	9N	15A			3N		2N	3N		14A	15A	

ID:

ID:

Record Layout Worksheet

ID: APPLICATION STUDENT - REGISTRATION Page 1 of 1 | Date 9/26/76 BY R.W. KAISER

ID: M-060 STUDENT CAMPUS ADDRESS

MEDIA CODE	SOC. SEC NO	LAST NAME	FIRST INIT	MI	RENT CODE (TYPE, COST)	LOCAL MAIL ADDRESS	CITY (POST OFFICE)	STATE	ZIP	PHONE NO.	DORM
060	9N	12A			3N	22A	13A	2A	5N	7N	2N

←FOLD

ID: M-062 STUDENT RESIDENCE (OFF-CAMPUS & OTHER THAN MAIL ADDRESS)

MEDIA CODE	Soc Sec. No.	LAST NAME	ACTUAL RESIDENCE	CITY	STATE	CAR POOL: N	DAY 1: PER/DAY	R	MILES	AY	TIME IN ARRIVE	TIME OUT DEPART	DAY 2	DAY 3	SEATS
062	DUPPED FROM M-060 9N	5A	22A	13A	2A			A	2N	A	3N	2N			

ID: M-064 COURSE PLAN (PRE-REGISTRATION & CHANGES) (TWO RECORDS IN ONE SEMESTER OK)

MEDIA CODE	SOC.SEC.NO	LAST NAME	EARNED CREDITS	MAJOR	PREREQ	SEMESTER (SEM, YR)	COURSE 1 (DEPT, COURSE NO, SECT, ALT, CR)	COURSE 2	COURSE 3	COURSE 4	COURSE 5	COURSE 6
064	DUPPED FROM M-060 9N	5A	3N	2N		3N	3A, 3N					

ID: M-066 STUDENT COURSE REQUESTS

MEDIA CODE	SOC SEC NO	LAST NAME	PROBABLE ACADEMIC AREA	SUBJECT MATTER DESCRIPTION	CREDITS	OFFERING SCHED.	EST FEE
066	DUPPED		9A	45 A		6A	2A

ID: M-070 COURSE SCHEDULES (1 RECORD FOR EACH COURSE AND EACH NON-STANDARD PERIOD)

MEDIA CODE	DEPT CODE	COURSE NO.	SECT	BEGIN DATE (DAY MO)	END DATE (DAY MO)	DAYS OF WEEK CODE	TIME BEGIN	TIME END	BLDG	ROOM NO	MAX. SIZE	SPEC FACIL	TYPE	CR	INSTRUCTOR #1 NAME LAST	1ST INIT	MI	INSTRUCTOR #2 NAME LAST	1ST INIT	MI
070	4A	4N	N	4N	4N	2N	4N	4N	2N	3N	3N	2N		2N	15A			15A		

ID: M-076 INSTRUCTOR-STUDENT COMMUNICATIONS (OFFICIAL NOTICES - FOR THE RECORD)

MEDIA CODE	DEPT. CODE	COURSE NO.	SECT	STUDENT SOC SEC. NO	STUDENT LAST NAME	RELEVANT DATE (MO DAY)	MESSAGE TO STUDENT	FORM CODE	MESSAGE CONTROL NO.
076	4A	4N		9N	15A		34A	2N	5N

ID: M-080 GRADES

MEDIA CODE	DEPT.	COURSE	DATE (MO. DAY)	CONTROL NO.	CARD SEQ	STUDENT #1 SOC SEC NO.	CR	GRADES 1	GRADES 2	STUDENT #2				STUDENT #3			
080	4A	4N	4N	5N	3N	9N	2N	2N	2N	9N	2N	2N	2N	9N	2N	2N	2N

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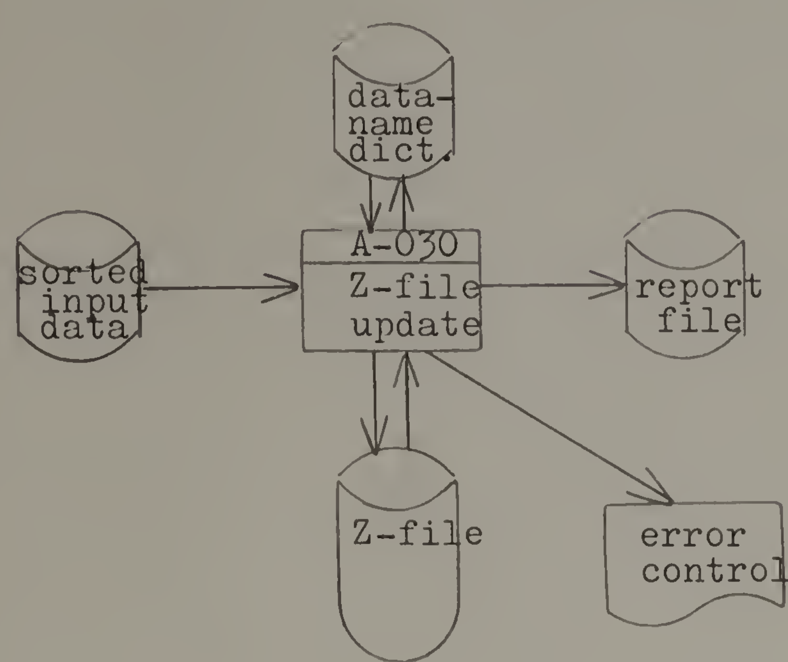
OPERATIONAL LEVEL - MAIN Z-FILE UPDATE PROGRAM

The Z-file update program is designed to place new data records on the Z-file, to update the Data-name dictionary with the address of the record on the Z-file, to list by age any and all error records on the Z-file, and to extract records from both the Z-file and the input data for use in the preparation of printed reports in subsequent print runs.



The input to the Z-file update run is the sorted input data from the main input edit program. This file has been sorted into record unmber sequence to facilitate the updating of the Data-name dictionary control record.

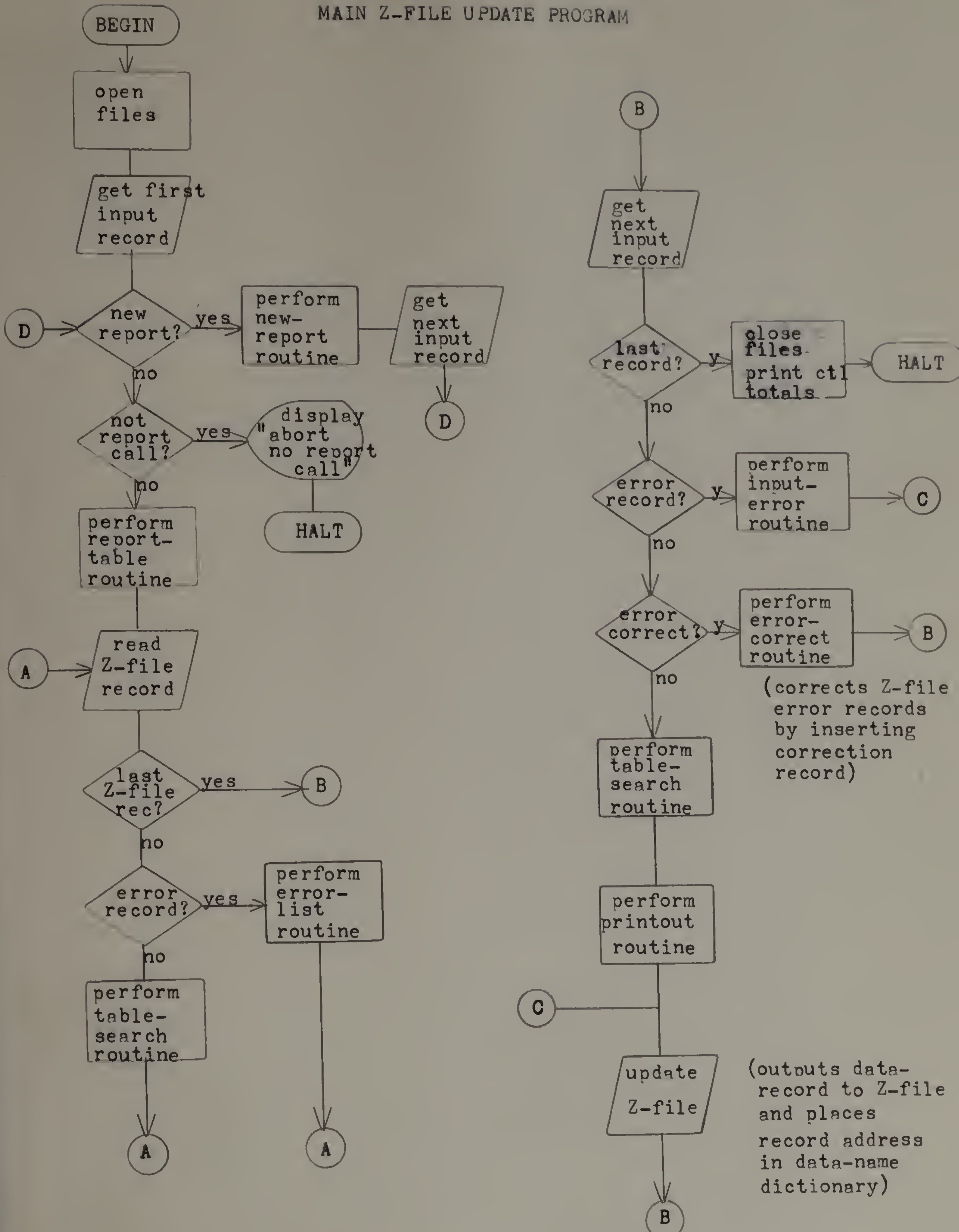
A New-report record first causes the report file to be updated with the parameters of the new report. These parameters are up to 24 record code identifiers (3 characters). The same record may be used to blank (delete) an existing report-control record in the file.

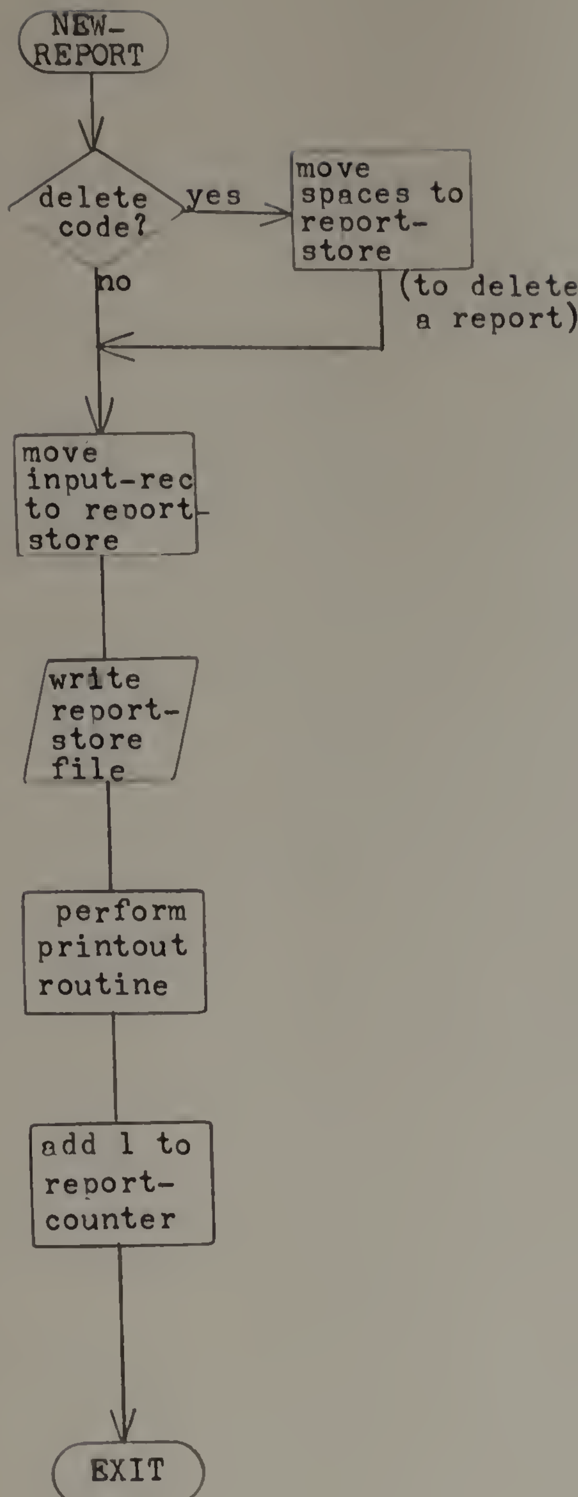
The next input record may be that of a report-call. This record indicates the identifier of all reports to be printed in a given pass through the Z-file. The report-call record causes the report control record for each active report to be placed in a table in memory as illustrated on the last page of the update block diagram (page 211).

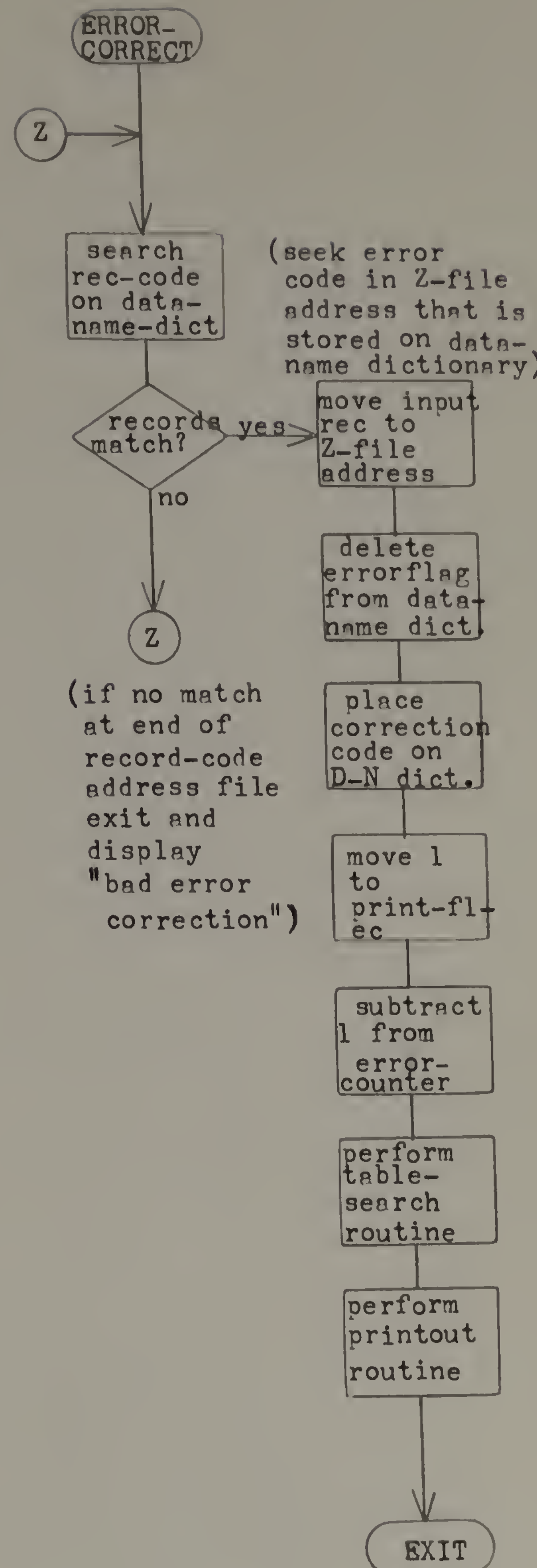
The Z-file is now read in its entirety. The Z-file is in sequence by the transaction date of each data record on the file. As the records are read from the file, error records are identified and printed on an aged error listing. Each record from the Z-file is tested against the report-code table to ascertain if a copy of that record is needed for a certain report. If so, the data record is output to the report file through a routine that uses data from the record to set up the appropriate report-sort code fields. The main body of the data record is then appended to the report sort field and moved to the report-file output area. This process is also illustrated on the last page of the update block diagram which follows.

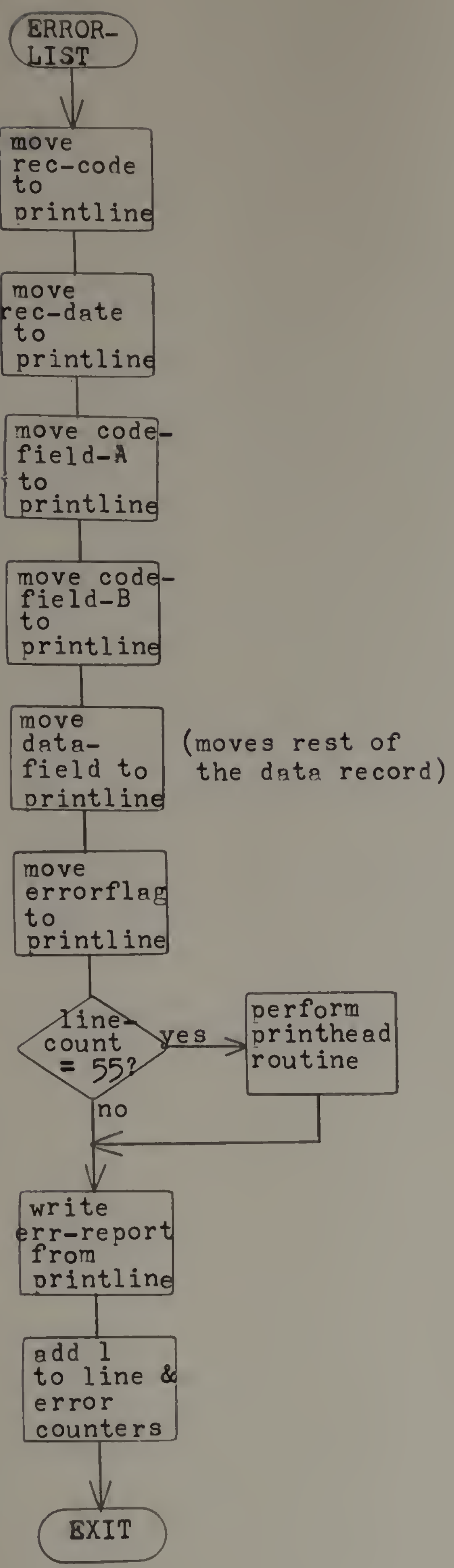
After the entire Z-file has been processed as above, the first input data record is read from the sorted input data file. Each data record from this input file is checked to determine if it should be printed on the error listing or if it should be output to the report file. An error record cannot be output to the report file. The input data record is then directly transferred to the Z-file without being modified or summarized. The address of the record on the Z-file is recorded on the Data-name dictionary behind other records on the Z-file that have the same record code. A one-character code field on the Data-name dictionary may also be used to provide further information about the record in addition to its location. An error record that is stored on the Z-file causes an error code to be placed in this field along with the address of the record. This will facilitate subsequent error correction.

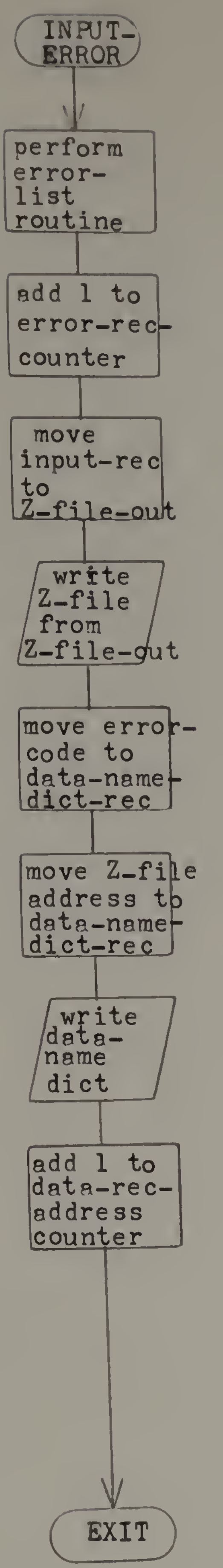
MAIN Z-FILE UPDATE PROGRAM




NEW-REPORT
delete code?
yes
move spaces to report-store
(to delete a report)
no
move input-rec to report-store
write report-store file
perform printout routine
add 1 to report-counter
EXIT


ERROR-CORRECT
Z
search rec-code on data-name-dict
(seek error code in Z-file address that is stored on data-name dictionary)
records match?
yes
move input rec to Z-file address
no
Z
(if no match at end of record-code address file exit and display "bad error correction")
delete errorflag from data-name dict.
place correction code on D-N dict.
move 1 to print-flec
subtract 1 from error-counter
perform table-search routine
perform printout routine
EXIT


ERROR-LIST
move rec-code to printline
move rec-date to printline
move code-field-A to printline
move code-field-B to printline
move data-field to printline
(moves rest of the data record)
move errorflag to printline
line-count = 55?
yes
perform printhead routine
no
write err-report from printline
add 1 to line & error counters
EXIT


INPUT-ERROR
perform error-list routine
add 1 to error-rec-counter
move input-rec to Z-file-out
write Z-file from Z-file-out
move error-code to data-name-dict-rec
move Z-file address to data-name-dict-rec
write data-name dict
add 1 to data-rec-address counter
EXIT

MAIN UPDATE REPORT RECORD EXTRACT

THE REPORT-ROUTINE AT BOTTOM OF PAGE IS DEVELOPED AT THE SAME TIME THE REPORT-WRITING PROGRAM IS GENERATED. THIS ROUTINE IS CALLED DURING THE MAIN UPDATE RUN WHEN THE REPORT EXTRACT IS INITIATED BY THE "REPORT CALL" RECORD.

SUBROUTINE REPORT TABLE:

ENTERED THRU "PERFORM" STATEMENT IN REPORT-CALL ROUTINE:

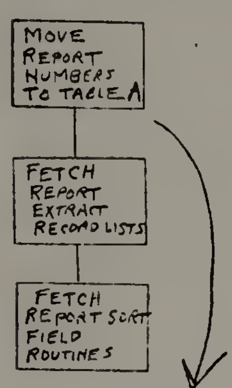
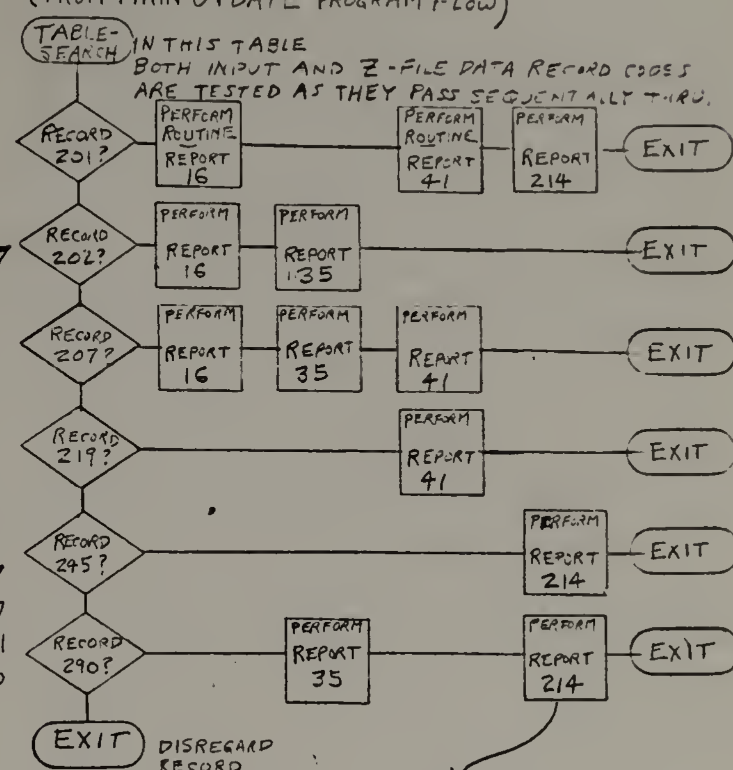


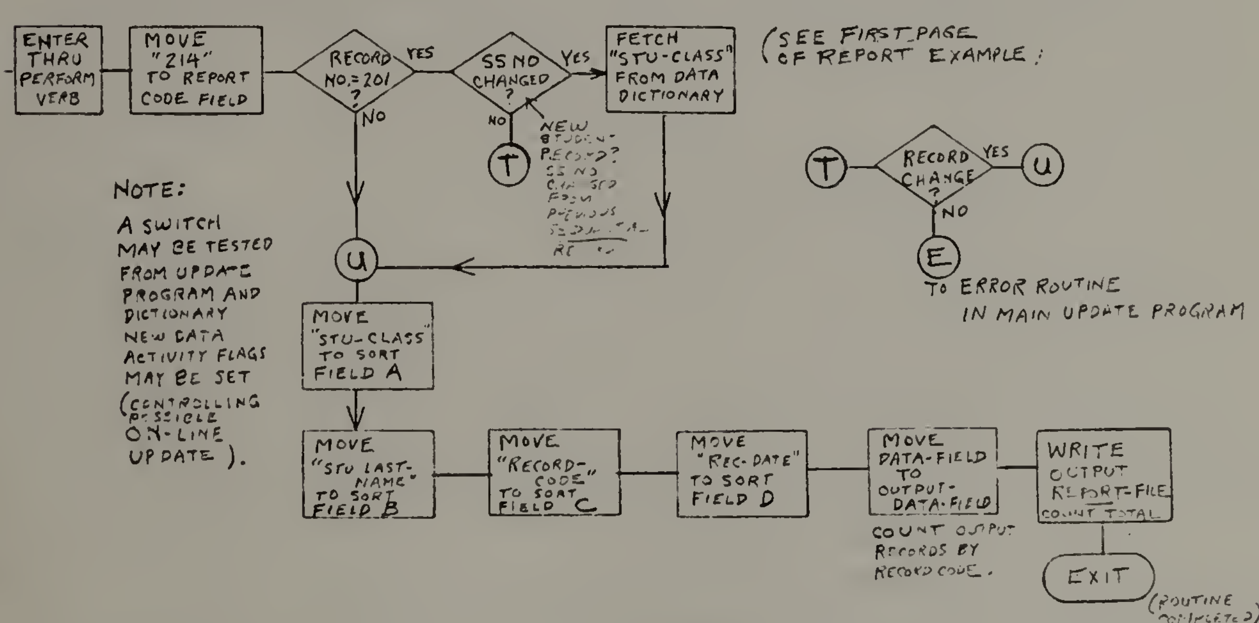
TABLE A

REPORT 016	RECORD	201, 202, 207
REPORT 035	RECORD	290, 202, 207
REPORT 041	RECORD	207, 219, 201
REPORT 214	RECORD	201, 245, 290

TABLE-SEARCH ROUTINE
REPORT-CALL TABLE EXAMPLE
(FROM MAIN UPDATE PROGRAM FLOW)



EXAMPLE ROUTINE TO DEVELOP RECORD REPORT-SORT FIELD: REPORT 214



Record Layout Worksheet

APPLICATION Z-FILE STUDENT-ADMISSIONS Page 1 of 4 | Date 10/10/76 BY R.W. KAISER

ID:

ID: 1-1-0020 INQUIRIES

SYS	TRAN	SHORTNAME		ZIP CODE	TRAN DATE	LAST NAME	TITLE	GIVEN NAME (LAST 13 CHAR)	MAIL ADDRESS	CITY (POST OFFICE)	STATE	OTHER NATION	PRO INT.
	0020	LAST 7A	1st M I	5P	4P	(LAST 10 CHAR) 10A	MS MR JR III N	13A	20A	13A	2A	3A	

← FOLD

← NEGATIVE = INITIAL FIRST, THEN GIVEN NAME

ID:

ID: 1-1-0060 RECRUITING INTERVIEWS ← NEGATIVE SIGN = INITIAL FIRST, THEN GIVEN NAME

SYS	TRAN	STUDENT SHORTNAME		SCHOOL CODE	DATE OF BIRTH	TRAN DATE	LAST NAME	GIVEN NAME	TITLE	ADDRESS	CITY	STATE	ZIP CODE	CODES: PROG	PREV	EVAL	INTERVIEWS
	0060	LAST 7A	1st M I	4P	MDY 6P	4P	(LAST 8 CHAR) 8A	(LAST 8 CHAR.) 8A	MS MR JR III N	18A	13A	2A	5N	INT X	A	A	2N

ID: 1-1-0080 RECRUITING- ADVISOR

SYS	TRAN	STUDENT SHORTNAME		INTEREST	SCHOOL CODE	TRAN DATE	ADVISOR LAST NAME	FIRST INIT.	M I	TITLE	POSITION	ADVISOR MAIL ADDRESS	ADVISOR CITY (POST OFF.)	STATE	ZIP CODE
	0080	LAST 7A	1st M I	2P	4P	4P	15A			MS MR DR DEAN REV.		18A	13A		

ID: 1-1-0120 SCHOOL NAME

SYS	TRAN	SCHOOL SHORT NAME	SCHOOL CODE	DIV		TRAN DATE	SCHOOL NAME	SCHOOL DIVISION NAME	CODES: SIZE	ACCRED	# PROG
	0120	7A	4P	2P		4P	35A	25A			

ID: 1-1-0140 SCHOOL ADDRESS

SYS	TRAN		SCHOOL CODE	ZIP CODE	TRAN DATE	SCHOOL ADDRESS (MAIL)	SCHOOL CITY	COUNTY	STATE	NATION	AREA CODE	PHONE NUMBER
	0140		4P	5P	4P	22A	13A	8A	2A	3A	3N	7N

ID: 1-1-0160 SCHOOL - FACULTY/ADMIN. ← NEGATIVE SIGN = INITIAL FIRST THEN GIVEN NAME

SYS	TRAN		SCHOOL CODE			TRAN DATE	TITLE	GIVEN NAME	INITIAL	LAST NAME	JR SR III N	POSITION NAME	PHONE NO.
	0160		4P			4P	TITLE: MS MR DR DEAN PRES. CHAN. SEN REP. PROF. GOV. REV. HON. A	14A		15A		24A	7N

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Record Layout Worksheet

ID: APPLICATION Z-FILE STUDENT-ADMISSIONS Page 2 of 4 | Date 10/10/76 BY: R.W. KAISER

←FOLD

ID: 1-1-0200 APPLICATION – NAME

SY	TRAN	SHORT NAME	SOCIAL SECURITY #	TRAN DATE	T	STUDENT LAST NAME	FIRST NAME	MIDDLE NAME	JR	STUDENT OTHER LAST NAME:	DATE OF BIRTH	DESIRE ENTRY	
	0200	LAST 7A 1st I M I	9P	4P	E N	(LAST 10 CHAR.) 10A	(LAST 13 CHAR.) 13A	(LAST 13 CHAR.) 13A	SR	(IF ANY) 13A	MO. DAY YR	S E M YR	

HYPHENATED – OTHER LAST NAME

ID: 1-1-0220 APPL.– PERMANENT RESIDENCE

SYS	TRAN		SOC. SEC. #	TRAN DATE	STUDENT PERMANENT ADDRESS	CITY	COUNTY	STATE	NATION	ZIP CODE	AREA CODE	PHONE NO.
	0220		9P	4P	22A	13A	8A	2A	3A	5N	3N	7N

ID: 1-1-0240 APPL.– PRESENT MAIL ADDRESS

SYS	TRAN		SOC. SEC #	TRAN DATE	STUDENT MAIL ADDRESS	CITY		VALID UNTIL	STATE	NAT.	ZIP CODE	AREA CODE	PHONE NO
			9P	4P	22A	13A		MO. DAY YR 6N	2A	3A	5N	3N	7N

ID: 1-1-0260 APPL.– RELATION

SY	TRAN		SOC. SEC. #	TRAN DAT	T	GIVEN NAME	IN	LAST NAME	MAIL ADDRESS	CITY	STATE	ZIP CODE	RELATION
	0260		9P	4P	E	MS MR DR 9A	I T I A	13A	18A	13A	2A	5N	

ID: 1-1-0280 APPL.– OTHER DATA ←λ OVERP ... = OFFICER

SYS	TRAN		SOC. SEC #	TRAN DAT.	CITIZ. OF:	V	V E	DISCHARGE DATE	TY	RA	MO. FULL TIME	FULL-TIME WORK EXPER.	POSITION	MINORITY CODE	FATHER'S OCCUPATION	MOTHER'S OCCUPATION	SPOUSES OCCUPATION		FIN A
	0280		9P	4P	3A		S A	B R A N	MO. DAY YR	L N	K N	EMPL 2N	(FIELD) 8A	6A		DECEASE 10A	DECEASED 10A	9A		2N

ID: 1-1-0300 APPL.– TESTS & STATUS

SYS	TRAN		SOC. SEC. #	TRAN DAT.	DEP	DEPENDENT	STATUS	MARITAL	DORM	REQ DEPT.	PLANNED MAJOR	LD	CAREER INTEREST	ENTRY APPL. DATE	SOURCE OF INFO ABOUT COL.	T E	DATE	T E	DATE	T E	DATE	T E	DATE	
	0300		9P	4P	SYCD				M?	3A	7A	CODE	14A	S E M YR.	3A	T	MO. YR	T	MO. YR	T	MO. YR	T	MO.	

ID: 1-1-0320 SCHOOL ATTENDED

SYS	TRAN		SOC. SEC #	TRAN DATE		FROM (DATE)	UNTIL (DATE)	LEVEL	SCHOOL CODE	SCHOOL NAME	SCHOOL ADDRESS..
	0320		9P	4P		MO. YR.	MO. YR		4N	27A	22A

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Record Layout Worksheet

ID: 1-1-0340 COUNSEL APPLICATION Z-FILE STUDENT - ADMISSIONS Page 3 of 4 | Date 10/10/76 BY: R.W. KAISER

SYS	TRAN		SOC. SEC. #	TRAN DATE	SEQUENCE	SCHOOL - CITY	STATE	ZIP CODE	AREA CODE	PHONE NO.	TITLE	SCHOOL COUNSELLOR'S LAST NAME	SCHOOL GRADE AVG.	
			9P	4N		13A	2A	5N	3N	7N	MS MR DR	15A	3X	

ID: 1-1-0360 APPL.- ALUMNI RELATION ←FOLD

SYS	TRAN		STUDENT SOC SEC #	TRAN DATE		M I	ALUMNI - LAST NAME	JR SR III	ALUMNI - PRESENT ADDRESS	PRESENT CITY	STATE	ZIP		GRAD YR
			9P	4P			15A	N	22A	13A	2A	5N		2N

ID:

ID: 1-1-0420 ADMISSION DATA MISSING

SYS	TRAN	STUDENT SHORT NAME LAST	1st I	M I	SOC SEC. #	TRAN DATE	NAME OF TEST SCORE MISSING	TRANSCRIPT MISSING (SCHOOL NAME)	OTHER MISSING MATERIAL (DESCRIBE)	TITLE	OUR PERSON TO CONTACT	PHONE EXT.	
		7A			9P	4P	6A	10A	18A	MS MR OR DEAN	12A	4N	

ID: 1-1-0440 ADMISSION DECISION

SYS	TRAN	STUDENT SHORT NAME LAST	1st I	M I	SOC. SEC. #	TRAN DATE	HIGH SCHOOL GRADE AVG		CLASS STANDING % TOP			# SCHOOLS		TOTAL COLLEGE CREDITS	CREDITS ACC.	G.P.A	HIGHEST DEGREE HELD	SAT VERBAL	SAT QUANT	TEST	SCORE	TEST	SCORE	STATUS CODE	ADMIT PERIOD SEM	ADMIT PERIOD YR	
		7A			9P	4P	4N	2A	2N	3A	3A			3N	3N	3N	3A	3N	3N	N	4N	N	4N	2N		3N	

ID: 1-1-0460 ADM.- CONFIRMATION

SYS	TRAN	STUDENT SHORT NAME LAST	1st I	M I	SOC. SEC. #	TRAN DATE	PROG	CAMPUS HOUSING BLDG	CAMPUS HOUSING ROOM	STATUS CODE	ENTER PERIOD SEM	ENTER PERIOD YR	TITLE	FACULTY ADVISOR FIRST NAME	FACULTY ADVISOR LAST NAME	
		7A			9P	4P	3N	2N	3N	2N			MS MR DR DEAN	14A	15A	

ID: 1-1-0480 STUDENT ADVISOR

SYS	TRAN	STUDENT SHORT NAME LAST	1st I	M I	SOC. SEC. #	TRAN DATE	STUDENT ADVISOR LAST NAME		N I	SOC. SEC. #	STUDENT ADVISOR MAIL ADDRESS ON CAMPUS (FOR FRESHMAN WEEK)	PHONE NO.	
		7A			9P	4P	15A			9N	17N	7N	

ID:

Record Layout Worksheet

APPLICATION Z-FILE STUDENT-REGISTRATION Page 4 of 4 Date 10/10/76 BY R.W KAISER

ID:

←FOLD

ID: 1-1-0600 STUDENT CAMPUS ADDRESS

STA	TRA	STUDENT SHORT NAME (LAST, 1ST, MI)	SOC. SEC. #	TRAN DATE	RENT CODE (TYPE, COST)	LOCAL MAIL ADDRESS	CITY (POST OFFICE)	STA	ZIP CODE	PHONE NO.	D OF M
		7A, I, I	9P	4P	3N	22A	13A	2A	5N	7N	2N

ID: 1-1-0620 STUDENT RESIDENCE (OFF CAMPUS OR OTHER THAN MAIL ADDRESS ACTUAL)

STA	TRA	STUDENT SHORT NAME (LAST, 1, MI)	SOC. SEC. #	TRAN DATE	ACTUAL RESIDENCE	CITY OR TOWN	STA	CAR POOL DAY 1					CAR POOL DAY 2	CAR POOL DAY 3	
	0620	7A	9P	4P	22A	13A		A	2N	A	TIME IN ARRIVAL 7N	TIME DEPART 7N			

ID: 1-1-0640 COURSE PLAN & CHANGES (PREREGISTRATION & CHANGES) (TWO RECORDS IN ONE SERIES OK.)

STA	TRA	STUDENT SHORT NAME (LAST, 1ST, MI)	SOC. SEC. #	TRAN DATE	EARN. CREDITS	MAJ	PREFER	STEM YR	COURSE 1: DEPT	COURSE NO	SECT	ALT.	CR	COURSE #2	COURSE #3	COURSE #4	COURSE #5	COURSE #6
	0640	7A	9P	4P	3N	2N		2N	3A	3N								

ID: 1-1-0660 STUDENT COURSE REQUESTS

STA	TRA	STUDENT SHORT LAST NAME	SOC. SEC. #	TRAN DATE	PROGRAM: ACADEMIC AREA	SUBJECT MATTER DESCRIPTION		OFFER SCHEDULE	EST
	0660	7A	9P	4P	9A	45A		6A	

ID: 1-1-0700 COURSE SCHEDULES (1 RECORD FOR EACH COURSE AND FOR EACH NON-STANDARD TIME PERIOD)

STA	TRA	DEPT CODE	COURSE NO.	SEC #	TRAN DATE	BEGIN DATE (MO DAY)	END DATE (MO DAY)	DAYS OF WEEK CODE	TIME BEGIN	TIME END	BLDG	ROOM NO.	MAX. CLASS SIZE	SPEC. FA. REQ	TYPE	CREDITS	INSTRUCTOR #1 NAME LAST	1ST MI	INSTRUCTOR #2 NAME LAST	1ST MI
	0700	7A	4P	P	4P	4N	4N	2N	4N	4N	2N	3N	3N	2N		2N	15A		15A	

ID: 1-1-0760 INSTRUCTOR-STUDENT COMMUNICATIONS (OFFICAL NOTICES - FOR THE RECORD)

STA	TRA	STUDENT SHORT LAST NAME	SOC. SEC. #	DEPT CODE	COURSE NO.	SECT	LAST NAME (LAST 10 CHAR.)	RELEVANT DATE (MO DAY)	MESSAGE TO STUDENT		MESSAGE CONTROL NO.
	0760	7A	9P	4A	4N		10A	4N	34A	2N	5N

ID: 1-1-0800 STUDENT-COURSE GRADES

STA	TRAN CODE		STUDENT SOC SEC #	TRAN DATE	DEPT.	COURSE NO.	SECT	CR.	GRADE 1	GRADE 2	CONTROL NO.	
			9P	4P	4N	4N			2N	2N	5N	

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SHADOW SYSTEM PROGRAMS

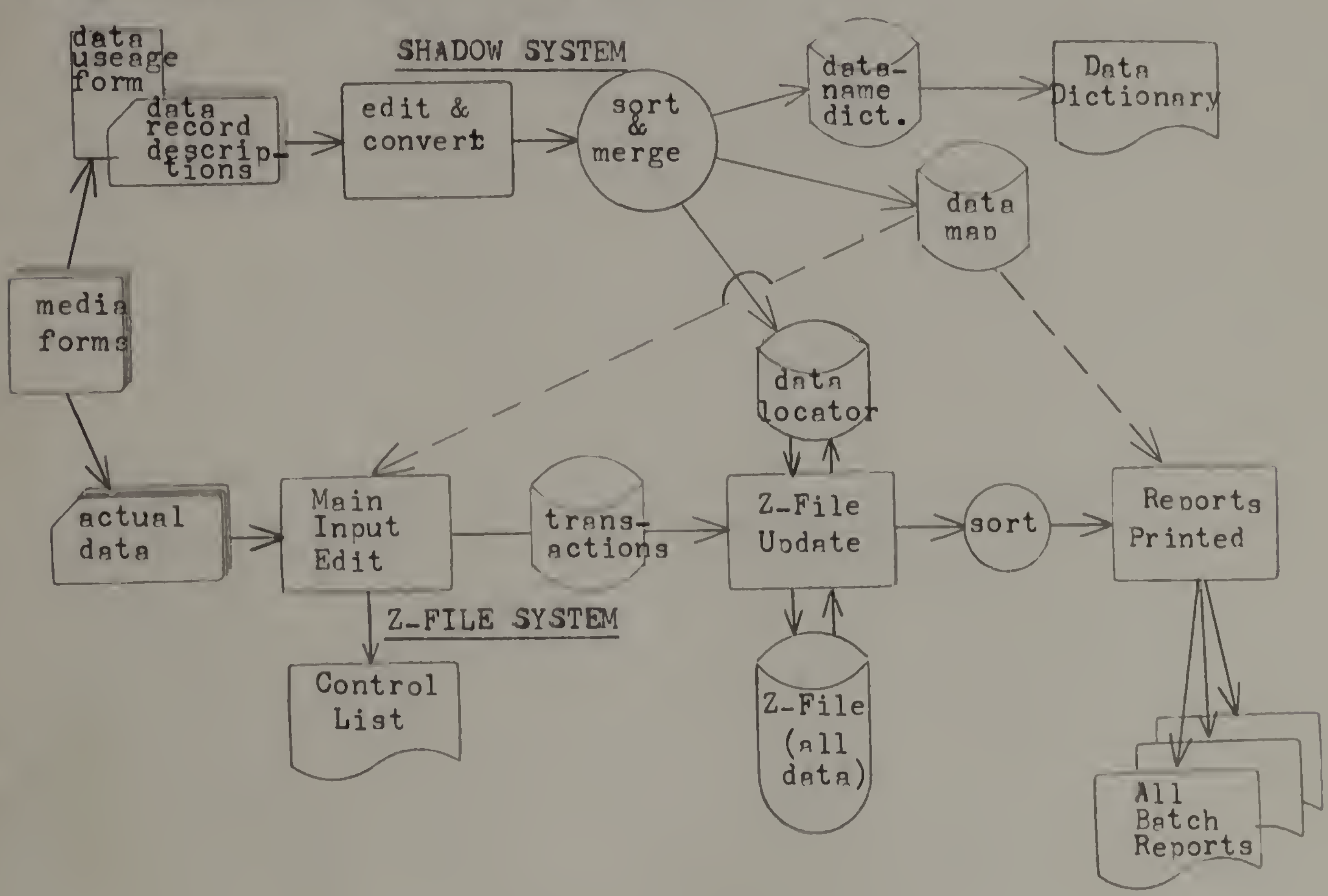
The Shadow System is a series of related computer programs and files that describe and control all transaction data records that flow through the Z-File system. The programs in the Z-File system have been described in previous sections of this Appendix. In the Z-File system, actual transaction data records are (1) fed into the system through the Main Input Edit Program, then (2) the data records are placed in storage on the Z-File, from which (3) they may be subsequently extracted for use in various computer-prepared reports. Control over these three main operational steps (programs) is maintained by the Data-name Dictionary and Data Map files. The Shadow System extablishes and maintains these two control files.

The definition and description of all data fields in the transaction records carried on the Z-File is provided by the Data-name Dictionary and Data Map files. This means that the data records that flow through the three steps of the Z-File system identified above do not have to be described in detail in each computer program. This not only simplifies the individual programs, it permits a virtually unlimited variety of transaction data records to be carried in the Z-File system. (Traditional COBOL programming methods required that each data record used in each program be fully described within each program. These repetitive data definitions complicated the programming and placed practical limits on the number of different types of data records the system could handle.)

The transaction data record control provided by the Data-name Dictionary and Data Map files of the Shadow System are the key to the basic operation of the Z-File system. The great variety of short transaction data records on the Z-File are the basis of the flexibility of the system. However, the computer programs that process the Z-File data might well be prohibitively complex if each data record had to be individually defined for each program. Further complexity would result from attempts to link these various data records together to form logical sub-groups of data within the Z-File. These data record descriptions and sub-group linkages are provided for all programs in the Z-File system by the Data-name Dictionary and Data Map files.

A diagram on the following page illustrates the relationship between the various files.

Transaction data that is to be carried on the Z-File is usually written first on some type of form or piece of paper that can be used as media for the system. Examples of transaction data forms might be applications, registration forms or grading sheets. It is possible that data from these and other media forms would eventually be input directly to the Z-File via on-line update, however, the initial system would be easier to set up using an input edit program to check the validity of all data coming into the system and to establish clear audit trails for the data. These media forms would be used as a source of descriptive information about the data fields contained on the forms. This descriptive information would be placed on the Data Useage Form. From the Data Useage Form, the descriptive information is punched into cards and fed into the Shadow System input edit program. In this program the descriptive information is converted and placed on the Data Dictionary and Data Map files (as well as a Data-Locator file that keeps track of data on the Z-File).



The Shadow System Input Edit program reads punched cards that have been prepared from the Data Useage Form. These cards contain descriptive information relating to the actual transaction data records that will later be fed into the Z-File system. The Input Edit program of the Shadow System converts the descriptive information from the punched cards into the proper format of the three control files: the Data-name Dictionary, Data Map and Data Locator. (See the following card and file layout sheets.) These three files and then sorted and merged directly with the descriptive information that may already be on the control files.

AN EXAMPLE OF DATA FILE CONTROL WITHIN THE Z-FILE SYSTEM

Z-File Data
(in original input sequence)

Location in Z-file	Record code	Type of data	Control field (student number)
7501	001	Student name	4204
7502	003	Home address	4204
7503	005	Local address	4204
7504	026	Parent name	4204
7505	028	Other data	4204
7506	001	Student name	1622
7507	003	Home address	1622
7508	005	Local address	1622
7509	026	Parent name	1622
7510	001	Student name	7937
7511	003	Home address	7037

Data Locator File
(controls Z-File)

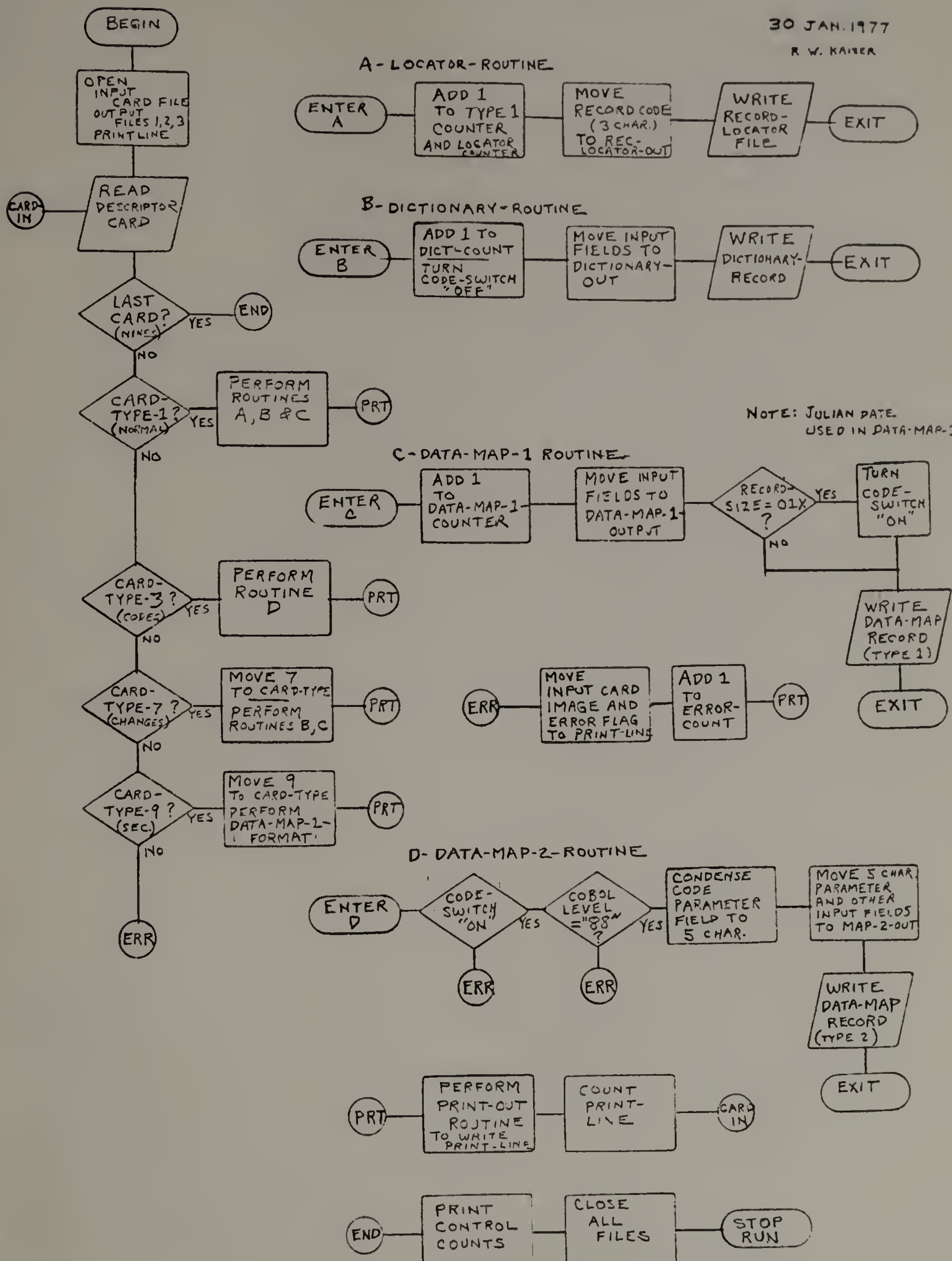
D/L loc.	rec. code	control field	Z-File Loc.	link next	link prev.
007	001	4204	7501	019	*
019	001	1622	7506	130	007
130	001	7937	7511	**	019
227	003	4204	7502	267	*
267	003	1622	7507	722	227
430	005	4204	7503	961	*
722	003	7937	7511	**	267
961	005	1622	7508	**	430

Record Control Table
(in computer memory)

Rec. code	Loc. begin	Loc. end	Count of records
001	007	130	3
003	227	722	3
005	430	961	2

Note: File inversion techniques may possibly be used in future to provide further record linkages.

SHADOW SYSTEM INPUT EDIT



Record Layout Worksheet

ID: APPLICATION SHADOW SYSTEM DATA DESCRIPTOR Page 1 of 1 | Date 29 JAN. 77 BY R. W. KAISER

INPUT CARD LAYOUTS

ID: DESCRIPTOR TYPE 1 - NORMAL DATA FIELDS ←FOLD

RECORD CODE	PASE/LINE NO.	CARD TYPE	INPUT RECORD DATA POSITION FROM / TO	DATA-NAME	COBOL LEVEL	OUTPUT REC CODE	OUT PUT POS.	FIELD SIZE (OUT)	INPUT DECIMAL PICTURE OR EDIT PARAMETERS		DATE CREATED (DUPED) MO DAY YR
3X	2N		3N / 3N	20X	2N	3X	2N	2N A	FIELD = D: PICTURE N: CODE OR RANGE 12X	CODE: UP TO 5 CHAR. SEPARATED BY COMMAS RANGE: (MAX) -99 THRU 99 (NUMERIC)	

ID: DESCRIPTOR TYPE 3 - CODE MEANINGS (UP TO 43 FOR EACH INPUT CODE FIELD) (ALL CODE FIELDS ARE ONE CHARACTER)

RECORD CODE	PAGE/LINE NO.	CARD TYPE	INPUT RECORD POS.	"LITERAL" CODE MEANINGS	COBOL LEVEL	OUTPUT REC CODE		CODE PARAMETERS		DATE CREATED (DUPED) MO DAY YR
3X	2N		3N	(COBOL DATA NAME)	88 2N	3X		12X FOR EACH MEANING: - UP TO 5 SINGLE CHAR. SEPARATED BY COMMAS. - RANGE (NUMERIC) UP TO "-99 THRU 99"	(POSSIBLE CODES: • ALPHABET EXCEPT I AND Ø • POSITIVE 0-9 • NEGATIVE 1-9)	

ID:

ID: DESCRIPTOR TYPE 7 - INPUT FORMAT CHANGE (CHANGED DATA SEQUENCE ON INPUT DATA RECORD)

		TYPE			DATE CREATED (DUPED) MO DAY YR
3X		7	SAME FORMAT AS CARD TYPE 1 ABOVE (OUTPUT FIELDS REMAIN SAME)		

ID: DESCRIPTOR TYPE 9 - SECURITY PARAMETERS

RECORD CODE		TYPE	CODE	SYSTEM SECURITY PARAMETERS OR ENCRYPTION ALGORITHM.		DATE CREATED (DUPED) MO DAY YR
3X		9 N	N	20A		

ID:

ID:

Record Layout Worksheet

ID: APPLICATION SHADOW SYSTEM DATA DESCRIPTOR Page 2 of 2 | Date 29 JAN. 77 BY R.W. KAISER

DISC FILE RECORD LAYOUTS

ID: RECORD LOCATOR – USED IN Z-FILE UPDATE

	COUNTER	NEXT RECORD LINK	LAST RECORD LINK	COPIC	Z-FILE ADDRESS	
A	4N	5N	5N	5A	5N	UPDATED DURING Z-FILE UPDATE - RANDOM ACCESS.

←FOLD

ID:

D = DECIMAL (SIGNED)
A = ALPHANUMERIC
N = NUMERIC

ID: DATA-NAME DICTIONARY – USED IN COBOL SYNTHESIZER

DATA-NAME	COBOL LEVEL	INPUT CARD REC. CODE	INPUT FIELD POS.	INPUT FIELD SIZE		REC. CODE (OUT)	REC. FIELD POS. (OUT)	FIELD SIZE (OUT)		DECIMAL PICTURE, IF ANY (INPUT DATA)	DATE CREATED MO DAY YR	
20A	2N	3A	3N	2N	A	2A	2N	2N	A	12A		TO BE UPDATED SEQUENTIALLY BY DATA-NAME

ID:

ID:

DATA MAP SEQUENTIALLY UPDATED, FIELD POSITION WITHIN RECORD CODE WITHIN SYSTEM.

ID: DATA MAP-1 USED IN INPUT EDIT AND REPORT PRINT RUNS.

TYPE CODE: 1 = DATA MAP-1
3 = DATA MAP-2
7 = RECORD FORMAT CHANGES

SYS CODE	REC. SEQ	TYPE	INPUT FIELD POS.	INPUT FIELD SIZE		COBOL LEVEL	OUT-PUT POS	OUTPUT REC. SIZE		RANGE OF DATA OR PICTURE	DATE CREATED	
3A	3N	N	3N	2N	A	2N	2N	2N	A	IF FIELD SIZE = D MAY CONTAIN 12A COBOL INPUT PICTURE	JULIAN DATE Y	IF SIZE = 01X THIS IS A CODE FIELD AND FOLLOWING RECORDS ARE CODE MEANINGS IF COBOL LEVEL 88. (UP TO 43 CODES, INCLUDING NEGATIVE)

ID: DATA MAP-2 USED IN REPORT PRINT RUNS.

	REC. SEQ	TYPE	REC POS.	COBOL LEVEL 88	CODES OR RANGE	LITERAL CODE MEANING	
	3N	N	2N	2N	5X	20A	POSSIBLE CODES: UP TO 5 SEPARATE CHARACTERS OR A RANGE BETWEEN 2 NUMBERS (INCLUSIVE) WITH AN * BETWEEN. TYPE CODE: 8 = CHANGES TO CODE MEANING TYPE 2. 9 = SECURITY PARAMETER

PROGRAM NARRATIVE

COBOL SYNTHESIZER PROGRAM

Introduction

Many colleges and universities have standardized on the use of the COBOL programming language for all, or nearly all, of their administrative computer programs. Of course, most institutions are left with a legacy of old computer programs that have not or cannot be converted to a higher level language. The cost and complexity of converting many of these old programs is simply too great. They are therefore used until they can be phased-out or until funds are available for a complete re-design of the system. The new programs are then usually written in COBOL.

The main benefit associated with the COBOL programming language continues to be its capacity for self-documentation. A poorly documented computer program becomes rapidly obsolete, as minor changes in the coding that are required in day-to-day use cause greater and greater disparity between the program coding and the documentation that explains the program. Since COBOL supplies its own documentation, this major problem is reduced. Since universities, and other large organizations, often have hundreds or thousands of individual computer programs in use, documentation of programs is a major problem that affects the operational control of the organization.

Because COBOL programs are sometimes slow to write, and due to the limited number of programmers on the staff, college and university administrators must often wait for weeks or months to have small programs written which will provide data which they require in their work. It would obviously assist these administrators if they could simply fill in a single program form which would in itself provide all necessary information for a computer program to be automatically generated from it. In fact, there are many such "report program generators" on the market. However, none in extensive use provides the important self-documentation of the COBOL language. It is for this reason that data center managers do not often encourage college administrators to use the "report generator" packages. Wide useage of such report generators creates large numbers of undocumented and uncontrolled computer programs. Either an administrator must become proficient in some "acceptable" language, (such as COBOL, FORTRAN, PL/1 or Assembler) or they must await the services of a staff programmer to do their job. The COBOL Program Synthesizer has been designed to allow an administrator to set-down on one form the requirements for basic reports from data that is already in the system. The single form is then used to quickly and automatically create a well-documented COBOL computer program which will then be used to print a report that contains the required information.

The use of a COBOL Program Synthesizer to obtain administrative information does not relate to "on-line" methods where a person uses a desk-side computer terminal and standard software commands to extract pre-determined information from a file. Nor does the Synthesizer relate to a trained person using such on-line languages as BASIC or "Real-Time COBOL" to write report programs on a terminal.

The COBOL Program Synthesizer is designed to permit a relatively unsophisticated administrator who has no (or limited) access to a computer terminal and no time to become a computer programmer to create a well-documented report program that will obtain the needed information.

The COBOL Program Synthesizer is not intended to be presented as an integral part of the Dissertation for the Doctor of Education. It is presented as a part of the technical material in the Appendix as an example of the flexibility, and potential power of the more simplified approach to educational data bank design that is represented in the design of the Z-File System.

Development

The idea of a simplified COBOL Program Synthesizer presented itself to this writer during the design of the "Shadow System" which is intended to define and control the data contained in the Z-File and which in itself greatly simplifies the writing of report programs. The Data Dictionary and Data Map files were designed to define both data records and data fields on the Z-File and to permit more rapid access of related data on the Z-File through the use of "chains" between related data fields. Chain-linking of related fields can be accomplished without limit in the Z-File through the use of the Data Dictionary. The Data Dictionary, when printed in report form, will allow the useage of all data in the Z-File to be monitored and controlled. It will also inform programmers of the type and nature of that Z-File data. In addition, it will provide most of the COBOL Data Division for a programmer who is writing a program to print a report from the Z-File data. Historically, the Data Division is the most time consuming part of a COBOL computer program. Since the Data Dictionary and Data Map had the potential to provide so much information to a writer of a report program, the possibility became evident to develop an automatic COBOL Program Synthesizer system which would make unnecessary the use of a programmer to write simple report programs for a college or university administrator.

How The System Works

When an administrator desires a new report from the Z-File data, he or she obtains a copy of the Data Dictionary and Report Synthesizer Form. The face of the form contains instructions for its completion, as well as a statement about the limitations of the Synthesizer. After making a rough draft of the desired report and deciding on the required data fields, the administrator copies the report layout from the draft to the bottom (Block D) of the Report Synthesizer Form. Column Headings for the various data fields on the report are then printed in Block C, (directly over Block D). The desired minor, intermediate and major totals are then coded in Block B. Then each data field on the report layout (Block D) is used with the alphabetic listing of all data that is contained in the Data Dictionary to fill-in Block A at the top of the Report Synthesizer Form. The Data Dictionary contains an alphabetic listing by data-name of each data field in each record in the Z-File. The Data Dictionary is divided into major system (such as Student, Plant & Equipment, etc.) to make each data listing smaller. The System code is an integral part of each data name.

Using the Data Dictionary, the administrator copies the exact spelling and format of the data-name onto the appropriate line of Block A on the Synthesizer Form. Then, following the instructions on the form, the administrator places a series of codes on each data-name line of Block A to indicate what she/he wishes to happen to the data item in order to get it into the correct format for the report. The system provides the capability for such diverse functions as summarization, averaging, printing and card punching. The system is not designed for complex reports. If the administrator cannot discern how to get the necessary information on the report, the Synthesizer Form should be given to a data center programmer for possible custom programming. All completed Report Synthesizer Forms are given to a programmer for review before being sent to the keypunch for the preparation of data cards that are made from the information on the Report Synthesizer Form. The data cards are verified and then input to the COBOL Synthesizer Program.

The COBOL Synthesizer Program analyzes the information on the input cards and compares this information with codes that are obtained from a comprehensive Data-name Dictionary that is maintained on magnetic disc. The computer program uses a complex series of routines to build COBOL program statements from the two data sources (Report Synthesizer Form and magnetic disc).

The COBOL program statements are printed and punched into cards. The printed program is evaluated by a technician at the data center. Any changes required in the COBOL program are made by punching and inserting cards in the COBOL statement card deck. Then the completed COBOL computer program is run through a "compiler" program where the English-language COBOL statements are converted to program coding that is in the language (binary) of the host computer. Then the program is stored until it is needed to print the required report.

During the COBOL Synthesizer Program, routines are also generated that will interact with the Z-File to extract the raw data from the file which will be needed to produce the final required report. Therefore, at the proper time, the needed raw data is extracted from the Z-File under control of the extract routine previously generated by the COBOL Synthesizer Program. It is sorted into the proper sequence called-for by the Report Synthesizer Form. Then the sorted raw data is passed through the newly created computer report program where the data is processed according to the needs of the administrator, and the desired report is printed.

REPORT SYNTHESIZER FORM

PLEASE TYPE
OR PRINT NEATLY

101 col. 11 YOUR ORGANIZATION	40	41-47 DATE MO / DAY / YR
102 REPORT NAME	40	41-47 REPORT NO.
YOUR NAME	65-80 YOUR POSITION	

103 col. 11 REPORT PURPOSE & DESCRIPTION col 80		
104		
105		
106		
107		
108		
YOUR SIGNATURE	AUTHORIZATION	ACCEPTED BY

|← FOLD BACK

INSTRUCTIONS:

The Report Synthesizer System enables the automatic development of computer reports. This form is used to provide all necessary information for the synthesis of the appropriate computer program.

The limitations of the Report Synthesizer are:

1. No more than 25 data fields on the print line, with no more than 25 corresponding numeric total fields.
2. No more than 3 levels of totals in each field (minor, inter. & grand).
3. Limited de-coding and encoding of data fields.
4. Complex program logic is restricted. The Synthesizer is at this time designed primarily for simple printing operations.
5. Report design is limited to the straightforward printing of data in columns. Complex formats must be custom programmed.
6. Data to appear on the report must already be stored in the computer files and must be identified in the printed Data Dictionary. (A copy of the Data Dictionary may be obtained from the Data Center.) Any data item that is stored in the computer system may be used, regardless of where is lies in the files.

To create a printed report to your specifications, follow these steps:

1. Make a draft of your report layout on any paper. This draft should show the data items in the logical left-to-right sequence that you desire on the final report. (Keep within the 13.2 in. form width.)
2. Indicate the columns of numeric data where you wish totals to appear.
3. Look in the Index of the Data Dictionary to find the general System and Sub-system(s) that contain the data which you need for the report. Then look-up the Data-name of each item in the alphabetic listing. Copy the exact (hyphenated) Data-name and System/Sub-system codes into the proper columns in Block A on the reverse side of this form.
4. Consider the sequence into which the data must be sorted if it is to appear correctly on your report (what field must be sorted within what other field). All the sort control fields (Data-names) must be indicated in Block A, even if they are not to print on the actual report. Place a "1" in the Block A "control level" column next to the Data-name of the most significant (primary) sort field. Place a "2" next to the Data-name of the secondary sort field. A maximum of four (4) levels of sort fields may be thus specified.
5. Specify the program logic in Block A according to Block A instructions.
6. Complete Blocks B, C and D according to the instructions therein. Then send or take the completed Form to the Data Center for review.

|←

REPORT SYNTHESIZER FORM

BLOCK A

DATA AND LOGIC   SEE INSTRUCTIONS ON REVERSE SIDE.   TEST COLUMN PERMITS COMPARISONS OF THE CONTENTS OF DATA-NAME WITH THE CONTENTS OF ANOTHER DATA FIELD CODE OR A LITERAL (SUCH AS '4' OR 'N') WHICH IS PLACED IN OPERAND A. IF THE COMPARISON IS SATISFIED, THE COMMAND(S) IN THE FUNCTION FIELD ARE PERFORMED. THREE TEST PERAMETERS MAY USED TOGETHER (SEE BELOW). FIVE DIFFERENT FUNCTION CODES MAY BE USED AT ONE TIME IN ANY FUNCTION FIELD. THE PROGRAM WILL PERFORM IN THE SEQUENCE THAT FUNCTION COMMANDS ARE LISTED. FUNCTION COMMAND PERAMETERS ARE LISTED (SEPARATED WITHIN COMMAND BY COMMAS AND BETWEEN COMMANDS BY SEMI-COLONS) IN OPERAND B FIELD. DO NOT MIX UP THE OPERANDS BETWEEN COMMANDS. MAINTAIN OPERANDS IN SEQUENCE OF FUNCTION COMMANDS. A NUMBER IN FIRST POSITION OF FUNCTION FIELD ESTABLISHES THAT NUMBER PRIORITY ...

		DATA-NAME	CONT	TEST	OPERAND A	FUNCTION	OPERAND B				DATA-NAME	CONT	TEST	OPERAND A	FUNCTION	OPERAND B
911	A	-						912	N	-						
913	B	-						914	Ø	-						
915	C	-						916	P	-						
917	D	-						918	Q	-						
919	E	-						920	R	-						
921	F	-						922	S	-						
923	G	-						924	T	-						
925	H	-						926	U	-						
927	I	-						928	V	-						
929	J	-						930	W	-						
931	K	-						932	X	-						
933	L	-						934	Y	-						
935	M	-						936	Z	-						

25 ALPHANUMERIC   10 ALPHAN   22 ALPHANUMERIC   25 ALPHANUMERIC   10 ALPHAN

FIELD-CODE 'Ø' MUST BE SLASHED.

ALPHABETIC WORD OR CHARACTER LITERALS MUST BE IN 'QUOTES'.

TESTS:
- N = NOT
- = = EQUAL
- G = GREATER THAN
- L = LESS THAN
- =G = EQUAL OR GREATER (FIELD-CODE/LITERAL, LITERAL [TO 5])
- =L = EQUAL OR LESS THAN
- B = BETWEEN (FIELD-CODE/LITERAL), (FIELD-CODE ± LITERAL)(LIT)
- PR = (TEST = PREVIOUS)

FUNCTIONS:
- P PRINT (FIELD-CODE), (AT FIELD-CODE)
- N COUNT NUMBER OF ITEMS, GIVING (FIELD-CODE)
- A AVERAGE UNTIL (FIELD-CODE) CHANGES, THEN PRINT AT (FIELD-CODE)
- C PUNCH FIELD IN CARD COLUMN (LITERAL), WHEN (FIELD-CODE) CHANGES
- L LINK AND PROCESS (LITERAL) IDENTICAL FIELDS IN RECORD.
- I DO THIS COMMAND ...
- + = ADD (FIELD), TO ...
- − = SUBTRACT
- X = MULTIPLY
- D = DIVIDE

BLOCK B

TOTALS   MINOR TOTALS IN FIELDS ___ TO PRINT WHEN ___ (FIELD-CODE) CHANGES. INTERMEDIATE TOTALS ___ WHEN ___ CHANGES

GRAND TOTALS IN FIELDS ___ TO PRINT AT END OF REPORT. REPORT DETAIL LINES TO BE SPACED-UP ☐ LINES AFTER PRINTING ...

BLOCK C

COLUMN HEADINGS   THE TITLE OF THIS REPORT WILL BE TAKEN FROM 'REPORT NAME' ON THE REVERSE SIDE. SHOW REPORT COLUMN HEADINGS IN EXACTLY THE FORM AND POSITION THAT YOU WISH THEM TO APPEAR. YOU MAY USE TWO LINES OF COLUMN HEADINGS.

BLOCK D

REPORT DATA FIELD LAYOUT   ON BLOCK D LINES 970-971, USE THE FIELD-CODE LETTERS FROM BLOCK A (ABOVE) TO INDICATE WHICH FIELDS ARE TO BE PRINTED WHERE. REPEAT THE FIELD-CODE LETTER IN EACH COLUMN OF THE RELATED REPORT FIELD (ie, DDDDD). THE SECOND LINE OF DATA (972-973) DEFINES THE EDIT CHARACTERISTICS OF THE FIELD-CODE PRINT AREA SHOWN DIRECTLY ABOVE IT (ALPHANUMERIC OR DECIMAL - USE "A's" OR "D's"). A DECIMAL POINT MUST BE SHOWN IN DECIMAL FIELDS. ONLY DECIMAL FIELDS CAN BE TOTALED. TWO EMPTY COLUMNS MUST SEPARATE EACH DECIMAL FIELD. ON THE THIRD (LAST) LINE, SHOW A LINE OF SAMPLE DATA AS YOU WISH IT TO APPEAR ON YOUR REPORT.

After the files are opened, the cards that have been punched from the Report Synthesizer Form are read into the computer working storage. There may be between fifteen and fourty-five cards used to contained this data (between 1200 and 3600 characters). Each card is processed according to its code. The cards are grouped into blocks of similar information (header and description, data definition and logic, totals, report headings and the report data format).

Using the header information and program description data, the Synthesizer program develops and prints the COBOL statements that make up the Environment Division and the Configuration Division in the COBOL program. The data in these two short divisions is mostly standardized, since the computer used by the administrative system is not often changed.

Then the cards from Block A on the Report Synthesizer Form are processed (data description and logic). The Data Dictionary record that matches each data name on a card is called-in from magnetic disc. A combination record that contains data codes from both sources is created and inserted into a data array (or table) that is ultimately arranged into the sequence of the record codes of the data dictionary record that contains the report data-name. From this first array (Alpha), other tables (Beta and Gamma) are developed to further refine the data organization. The data in these tables is then used to format and print COBOL statements for the Data Division File Section. The Synthesizer program iterates through each data-name record from Block A until all data records in the input file section of the Data Division have been output as printed COBOL statements.

Further analysis by the Synthesizer program of the array Alpha then premits the development and output of COBOL statements relating to output files (print-line and card-punch).

A complex series of program subroutines then evaluates the editing requirements of the report print-line, and COBOL statements for the Working Storage Section are developed and output to printer and punch. Further routines evaluate the many requirements for working storage of the report program, and the appropriate COBOL statements are formulated and output. Then the requirements for report totals are obtained from cards that were punched from Block B on the Report Synthesizer Form. Working storage areas are set up for these totals, and a series of switches is set to relate arithmetic routines to these totals. The required COBOL statements are developed and output.

Information on the report format from Blocks C and D on the Report Synthesizer Form is then evaluated. Working storage areas are set up in COBOL statements and output. Switches are set to control print routine development later when the Procedure Division of the COBOL program is being generated.

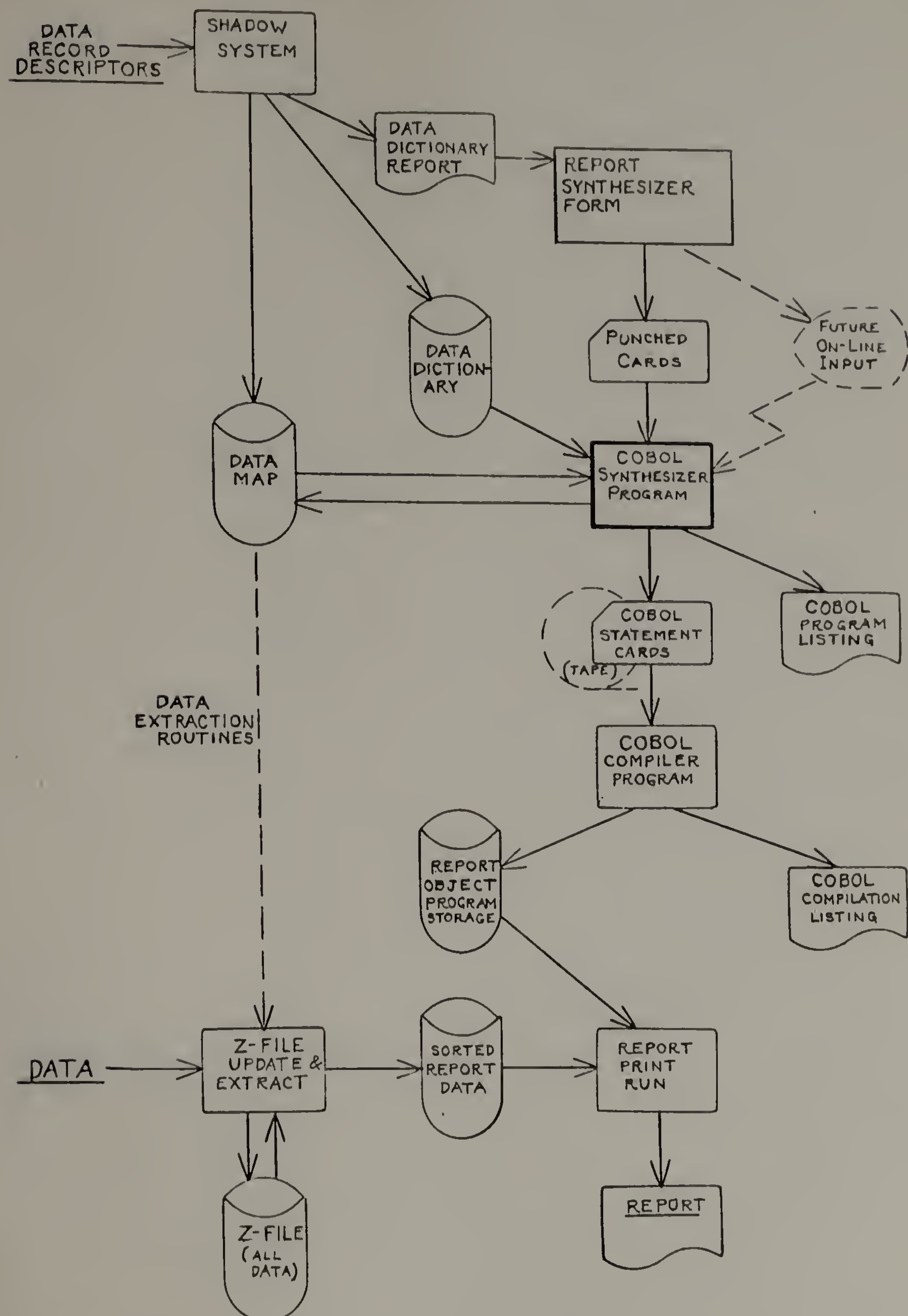
Then further working storage areas are set up to relate to the logical and arithmetic operand codes from Block A (data-name) on the Report Synthesizer Form. These COBOL statements are formatted and output to printer and punch.

The COBOL Procedure Division is developed by a complex series of inter-related subroutines that are called into action by the many function codes and operands from each data-name record (Block A on the Report Synthesizer Form). The series of logical switches and subroutine linkages that are required by the Synthesizer program to develop the COBOL statements is too complex to be more fully described here. While portions of the Procedure Division require Synthesizer logic that is complex, the COBOL statements themselves have been kept as straight-forward as possible. Many of the COBOL program routines (such as PRINT-LINE and PUNCH-OUT) are standardized, and require only slight modification for specific COBOL programs.

After the printing of the last COBOL statement has been completed, the program uses array Alpha to develop a series of routines that will extract report data from the Z-File during the Z-File Update and Extract run. These routines are then stored at the end of the DATA MAP file for later use. The COBOL Synthesizer Program then closes files and terminates.

SYSTEM FLOW CHART

COBOL PROGRAM SYNTHESIZER



CONCEPTUAL BLOCK DIAGRAM

COBOL SYNTHESIZER PROGRAM